Indiana-American Water Company, Inc.

401 Camby Court • P.O. Box 570 • Greenwood, Indiana 46142-0570 • (317) 885-2400 • (317) 885-2406 FAX

July 9, 1997

Mr. William Buller
Waste, Pesticides and Toxics Division
U.S. EPA (DRE-8J)
77 W. Jackson Boulevard
Chicago, IL 60604

Re: Contaminated Groundwater and Soil
Franklin Power Products/Amphenol Facility
Franklin, Indiana

Dear Mr. Buller:

Indiana-American Water Company has completed its review of the aforementioned site and its impacts upon our operation. Groundwater flow modeling was conducted for the Hurricane Creek aquifer northeast of the town of Franklin, Indiana. Water quality data collected from raw water at our Webb well field since 1988 have shown a steady increase of concentrations of *cis* 1,2-dichloroethylene from below detection to over 100 ug/l (ppb) in well #3.

The flow modeling indicated that the site of the Franklin Power Products (FPP) clean-up activity is in the capture zone of well #3 at the Webb well field. The modeling was verified by a sensitivity analysis of input parameters which further suggested that, for all reasonable hydrologic conditions, water from the FPP site would arrive at the public water supply wells in 7 to 12 years.

This finding directly conflicts with the conclusions reached in the Statement of Basis about the likelihood that off-site migration of contaminated groundwater could pose a risk to the general population.

Additional solute transport modeling was done to assess the potential for natural processes, such as hydrodynamic dispersion, chemical retardation, and biochemical decay, to reduce the concentrations of the contaminant below levels of concern when it arrives at the pumping center. Instead, this modeling showed that the concentrations in the well field would be in the range of what has been measured in the raw water at the well field.

In order to mitigate the threat posed by the contamination to the Franklin public water supply system we are considering both operational and engineering changes. The results of our consultant's analysis are included in the enclosed report.

Our analysis suggests that the work done by Franklin Power Products did not adequately consider the possibility that the contamination could expose large populations. Consequently the risk analysis, and the entire remediation decision which it is based on, must be called into question. The concerns of the Indiana-American Water Company about off-site releases go to the heart of the rationale for selecting a clean-up option. It is important to our company, and the community of Franklin, Indiana, that these concerns be adequately addressed by the remediation plan for the site.

Please contact me if you have any questions or comments.

Sincerely yours,

INDIANA-AMERICAN WATER COMPANY, INC.

Eric W. Thornburg
Vice President-Operations

EWT/me

Enclosure

cc: Mary Hoover, IDEM, w/enclosure
Bill Ryan, USEPA, w/enclosure

## Table of Contents

## *Introduction*

The purpose of this report is to provide information which can be used by the Indiana American Water Company to comment on the EPA notice regarding the Franklin Power Products clean-up plan. This work can be used to protect the drinking water supply of Franklin, Indiana. As such, the analyses presented here are part of a comprehensive wellhead protection effort for the Webb well field, which supplies drinking water to the town of Franklin. This report was prompted by the public notification of the final clean-up plans for the Franklin Power Products/Amphenol Facility and the request for public comment. In this notice (see Attachment 1) the EPA described the remediation plans for sites where solvents and other materials had been released into the soil and groundwater during the two decades between 1965 and 1985. The releases described in the "Statement of Basis" and the documented contamination found on the site all occurred prior to the detection of volatile organic compounds in the raw water at the Webb well field. These releases and the current level of soil contamination are all documented and described in the Resource Conservation and Recovery Act Facility Investigation (RFI) reports. The following 4 questions guided the work done for this report:

1. Is the groundwater in the alluvial aquifer along Hurricane Creek moving from the Franklin Power Products facility towards the Webb well field?

2. If contaminated groundwater can move to the well field, how long would it take to arrive?

3. Are there other known sources of groundwater contamination which could be responsible for the observed VOCs in the Webb well water?

4. What response is required to prevent further contamination of the public water supply of the town?

A series of groundwater modeling analyses were conducted to evaluate the flow conditions in this aquifer in order to determine the likely flow paths in the vicinity of the well field. In addition, 1-dimensional contaminant transport modeling was conducted to consider the effects of dispersion, chemical retardation, and biodegradation on the expected concentrations in the well water. The final section in this report responds to each of the questions posed and presents some conclusions about source water protection activities near this and other Indiana American well fields.

The report is organized into five sections. The first describes the history of the site, the second outlines the hydrogeology of the area, the third section explains the regional groundwater flow modeling used to determine flow directions, the fourth presents the results of contaminant transport modeling, and the final section is considers each of the 4 questions posed that include a response to the current situation. In all cases the reader should understand that the groundwater modeling was done with limited observations in the area between the Webb well field and the town of Franklin. The conclusions reached in this report are based on this modeling and additional hydrogeologic data would be required for greater certainty.

## Site History

Through the first twenty years of operations the Franklin Power Products facility handled a variety of hazardous wastes, including:

- spent solvents (e.g., tetrachloroethylene, trichloroethane, methyl chloride, carbon tetrachloride, toluene, methyl ethyl ketone);
- waste water sludges from electroplating operations;
- spent cyanide plating solutions;

In some cases the hazardous materials were stored in large (500-1000 gallon) tanks and in other cases the materials were stored in cement vaults. Through a variety of circumstances there were releases into the sanitary sewer system. The sewer pipes serving the facility were damaged and released the contaminated water into the subsurface in the vicinity of the site. Groundwater and soils have been found in several areas with high concentrations of PCE. It is understood that this particular contaminant degrades into daughter compounds such as trichloroethene (TCE) and dichloroethylene (DCE).

The contamination was discovered in the early 1980's and remedial activities took place at the site in 1984 and 1985. Monitoring wells were installed and soil was excavated and removed from the area. Later, in the early 1990's a RCRA Facility Investigation (RFI) was conducted to better characterize the contamination on site and design a more effective remediation system. An investigation of groundwater contamination was conducted using a truck-mounted geoprobe sampling device. Concentrations over 2 parts per million of total VOC in groundwater were measured in the "upper" aquifer. Several interim corrective measures have been implemented to minimize off-site contamination. A groundwater recovery system (three on-site pumping wells) became operational in February 1995. The idea of this system is to intercept any migrating contaminants in the shallow groundwater, put it through an air-stripping treatment system, and discharge the treated water into the sewer system.

The design of the remediation system being used to control off-site migration of contaminants, as well as the risk analysis presented in the EPA Statement of Basis, are based on a four-layer conceptual model of the aquifer system in the area. The data used to support the conceptual model comes from the local geoprobe sampling and monitoring well analysis which indicates that there is a low conductivity layer on the site which separates the thin upper aquifer from the deeper aquifer. Based on this conceptual model, attention is focused on contamination in the upper zone and groundwater flow in the immediate vicinity.

### Hydrogeology of the IAWC Well Field

The community water supply well field for Franklin, Indiana is owned by Indiana American Water Company, a subsidiary of the American Water Company. The Webb well field is located just northeast of the town of Franklin, Indiana approximately 1500 feet east-northeast of

3400

the Franklin Power Products (FPP) cleanup. The pumping center is composed of four wells, two wells on either side of Hurricane Creek (Figure 1). Streams in this area flow south and east, towards the East Fork White River. Hurricane Creek is a tributary stream of Young's Creek, which, in turn, flows into Sugar Creek (Figure 2).

The drilling logs for the well field describe the unconsolidated section at that location as predominantly sand and gravel with streaks of clay. Well logs evaluated for this report indicated a sharp contrast between the outwash and the till, with the outwash reported as having over 25 feet of sand and gravel and the upland till formation having less than 5 feet of sand within an otherwise continuous clay section. Southwest of Franklin, the unconsolidated material is very thin over a relatively impermeable Devonian shale. The following section of this report outline the distribution of recharge, transmissivity, and high capacity pumping in the region.

## Transmissivity

The outwash deposits along Hurricane Creek are incised into a clayey till formation which extends to the west toward the West Fork White River. The discontinuous sand and gravel within the formation makes the hydraulic properties generally less uniform than what might be found in outwash deposits (Meyer and others 1978). The large scale modeling studies completed in the area by the USGS indicate that these inter-till aquifers have transmissivities ranging from less than 1,000 to near 10,000 $ft^2$/day. Local well logs suggest that there is between 1 and 8 feet of sand and gravel in the till formation directly west of the Webb well field. Assuming the hydraulic conductivity of the sand and gravel layer is about 200 feet/day, the transmissivity of the till should be in the range of 200 - 2,000 $ft^2$/day. The outwash deposits along Hurricane Creek have more sand and gravel than the till, in some cases up to 65 feet of gravel above bedrock. Consequently, the transmissivity of the outwash is expected to be about an order of magnitude greater in the outwash than in the till.

## Recharge

Under natural conditions the groundwater in the outwash aquifer along Hurricane Creek is recharged by precipitation and discharges into the creek. In central Indiana the estimates of recharge into till formations, based on tritium tracing and water budget analysis, range from about one to three inches. Recharge into outwash aquifers has been estimated to be between 6 and 14 inches/year (Herring 1976, Bailey and Imbrogiotta 1982, Arihood 1982, Smith 1983).

## High Capacity Pumping Wells

The Indiana Department of Natural Resources mapped the aquifers in Johnson County as a part of a project to evaluate the water resources of the State in the 1960's (Uhl 1966). The map for the county indicates that the narrow band of outwash/alluvium along Hurricane Creek is a part of a formation which yields over 250 gallons per minute. The same report suggests that wells in the till area may yield up to 100 gallons per minute. In the immediate area the most important high capacity pumping wells are the community water supply wells owned by Indiana American Water Company (Attachment 2). During 1996 the average annual pumping rate for the well field was about 2.5 Million gallons per day (MGD). The daily withdrawals varied between 1.5 and 3.7 MGD (Figure 3). This pumping rate is considered to be within the "safe yield" of the well field. note

## *Regional Modeling*

In order to evaluate the potential effects of contamination at the FPP facility on water quality at the Webb well field, groundwater flow modeling was done in the region surrounding Franklin, Indiana. This modeling analysis was used to determine whether contamination at the FPP site would end up in the well field or move directly south towards Hurricane Creek. A regional analytic element model was constructed for the unconsolidated aquifer system between the West Fork White River on the west and the Big Blue River on the East. The model domain extended from south of Franklin to as far north as the middle of Marion County. More detail was used to describe features nearer the site.

The theory behind analytic element modeling can be found in Strack (1989) and Haitjema (1995). Analytic element models do not break the aquifer into grid blocks, instead the surface water features are discretized into straight line elements called *line sinks* which can either remove water from the aquifer (a gaining reach) or inject water into the aquifer (a losing reach). Streams near the area of interest are modeled in more detail than those further away (Figure 4). Variations in aquifer properties are modeled by defining closed domains with different hydraulic properties (see Attachment 2). For this project the unconsolidated section was modeled as one hydrostratigraphic unit. The commercial code GFLOW was used for the project (Haitjema and Kelson 1995).

## Conceptual Model

The higher transmissivity sand and gravel outwash material along Hurricane Creek and West Fork White River were modeled as separate domains from the surrounding till unit (see Figure 5). Recharge and transmissivity for the outwash domain were modeled as higher than in the till (Figure 6). The conceptual model of the aquifer had a constant base elevation of 575 ft which is close to what has been reported in the area (Gray 1982). Flow near the well field was unconfined but was confined in most of the region. Porosity was assumed to be constant (0.25) throughout the system. The purpose of the conceptual model is to describe the complex aquifer in a simple manner while maintaining the essential hydraulic features of the system (Figure 7). The location of the transition between the outwash and till aquifers was inferred from topographic information and other related data in Marion County. The stream was modeled with a resistance layer between the aquifer and the stream bottom. However, the hydraulic resistance between Hurricane Creek and the aquifer are unknown in the project area. big question

pump tests?

Given the limited field data available there was a relatively high degree of uncertainty in the input parameters used in modeling. In order to determine how much this uncertainty affected the results, the input parameters were varied to see how each altered predictions of groundwater flow direction. The two-dimensional, steady-state model was calibrated with regional and local water level measurements and then used to determine how flow directions varied for a range of conditions. These scenarios are summarized in Table 1.

Table 1. Summary of groundwater model input parameters

| *Run Name* | *K [ft/d]* | *river resistance [days]* | *recharge [in/yr]* | *pumping rate [MGD]* |
|---|---|---|---|---|
| BASE | 150 | 25 | 12 | 2.5 |
| N8 | 150 | 25 | **8** | 2.5 |
| K200 | **200** | 25 | 12 | 2.5 |
| K100 | **100** | 25 | 12 | 2.5 |
| c5 | 150 | **5** | 12 | 2.5 |
| c50 | 150 | **50** | 12 | 2.5 |

## Modeling Results

For each scenario, particle tracking from the FPP site was done to determine if the FPP site may be in the capture zone of the well field. The modeling indicated the following general relationships:

1. *The lower the modeled resistance between the stream and the aquifer, the more the pumping wells can induced recharge from the stream and the less that is pumped from the aquifer. This induced surface water inflow to the aquifer reduces the size of the capture zones proportionately.*

2. *Given moderate-to-good hydraulic connection between the stream and the aquifer, the size of the capture zone increases as recharge into the aquifer decreases.*

3. *The higher the transmissivity in the aquifer, the more likely it is that water can be pumped underneath Hurricane Creek into one of the two wells on the opposite (southeast) side.* ?

Each modeled scenario was evaluated by comparing it to a "base case". The base case scenario was a best fit combination of the model inputs that were the benchmark for future model runs. In all but one of the scenarios, the modeled path lines traced from the FPP facility terminated in the Webb well field. The modeled travel times from the FPP site to the well field varied from 7 to 12 years. The modeled path lines for these different scenarios are shown in Figures 8 through 13. It is clear that stream/aquifer resistance is the property which most affects the flow directions at the site.

## Effect of Stream/Aquifer Resistance

In this case, the problem of modeling the capture zones of the Webb well field is nearly reduced to a question of how much water comes from the stream. If there is any substantial layer of clay or silt between Hurricane Creek and the aquifer, resistance will be high enough to buffer the impact of the creek and force the wells to pump water from the aquifer and from the FPP site (Figures 10 and 11). Unfortunately, there is little direct information about the particle size distribution of the soils beneath the Creek. Other modeling studies have found, however, that smaller streams generally have generally higher hydraulic resistance than larger rivers (Bailey and Imbrigiotta 1982). In some cases modeling investigations have been validated by measuring water levels in the aquifer and the stream while one of the two levels change.

? pump test dd

At the Webb well field a change in the hydraulic resistance over an order of magnitude changes the amount of water coming out of the creek by nearly a factor of two. More importantly, the resulting flow directions will change more than 90 degrees at the FPP site (i.e., from straight south to east-northeast).

Table 2. Contribution of Hurricane Creek Water to Webb wells for a range of modeled scenarios.

| *Run Name* | *K [ft/d]* | *river resistance [days]* | *recharge [in/yr]* | ***estimated contribution of creek to the wells [MGD]*** |
|---|---|---|---|---|
| BASE | 150 | 25 | 12 | **1.33** best fit |
| N8 | 150 | 25 | 8 | **1.46** |
| K200 | 200 | 25 | 12 | **1.41** |
| K100 | 100 | 25 | 12 | **1.30** |
| C5 | 150 | 5 | 12 | **2.30** no draw fr FPP |
| C50 | 150 | 50 | 12 | **1.19** |

what about the well lop

The geologic data from local well logs suggests that there is between 5 and 20 feet of clay in the upper soils near the stream. The modeled resistance for the base scenario could be produced by a five foot thick resistance layer with a hydraulic conductivity of 0.2 feet/day. The reasonableness of this estimate, along with measured water levels at the site suggest that there is substantial resistance between the Creek and the aquifer.

## *Transport Modeling*

With the one exception of the low resistance scenario, each of the other flow modeling results indicated that groundwater would move from the FPP facility to the southwestern well in the Webb well field (well #3). Since 1988 Indiana American has taken raw water samples every three to four months from each of the four wells. During the past 8 years the concentration of *cis*1,2 dichloroethylene (DCE) in well #3 has increased from below detection to above the drinking water standard (Figure 14). While water quality in the finished water never exceeded the EPA standards, this increase did cause some concern. The flow modeling suggests that it is likely that the source of contamination in well #3 is the FPP site. Additional solute transport modeling was done to evaluate the potential effects of dispersion, retardation, and decay.

TCE at source

The computer program SOLUTE was used to model one-dimensional transport of DCE from a source to a down-gradient receptor (Beljin 1993). The most basic assumptions of the model are that the entire aquifer thickness is contaminated and groundwater flow through the aquifer is uniform. The analysis was used to determine how much the concentrations could decrease from natural attenuation processes along the flow path. A summary of the model input data is presented in Table 3.

Table 3. Summary of contaminant transport model input data.

| CHEMICAL PROPERTY | AQUIFER PROPERTY | PARAMETER VALUES |
|---|---|---|
| Koc | foc | R = 1.5 - 2 |
| half-life | | 1 - 10 years |
| initial concentration | | 2.2 mg/l |
| | distance from source to receptor | 1500 meters 4500'? |
| | dispersion ($D_L$) | 1 - 100 meters |
| | pore velocity | 0.4 m/day |
| release duration | | 1 - 10 years |

DCE?

DCE?

The estimates of pore velocity came directly from the GFLOW modeling. While the modeled pore velocity along the flow path varied from 0.2 m/day to over 1.0 m/day, the average (i.e., total distance/total time) was 0.4 m/day. 1.2'/D The estimates of the organic carbon partitioning coefficient of DCE (Koc) and estimates of half-life in groundwater came from an EPA solute transport and fate data base developed by Sims and others (1990). The fraction of organic carbon in the aquifer matrix (foc) came from discussions with several area consultants about aquifer properties in the area. Dispersion coefficients for the aquifer are based on Gelhar (1989). The initial concentration value and the estimate of release duration ? each came directly out of the RFI reports. The complete input data files used for the SOLUTE runs and graphs of the output are included as Attachment 4.

## *Conclusions*

The results of the transport modeling generally corroborate the groundwater flow modeling analysis. The transport modeling results indicate that the concentrations in the water 1500 meters down-gradient would, depending on the combination of parameters used, range between 0.1 and 0.4 of the initial concentration. The flow modeling suggests that about one tenth of the capture zone of Webb well # 3 could be contaminated by the FPP site, diluting the contaminant by another order of magnitude. This means that the expected maximum concentrations in the well would be anywhere from 20 to 100 ug/l, roughly matching the observations.

The modeling described in this brief report indicates that the DCE contamination at the Franklin Power Products facility is very likely ending up in the community drinking water supply. It is very important that action be taken soon to protect the water resource.

*Response to Questions*

| QUESTION | ANSWER | COMMENTS |
|---|---|---|
| Is the groundwater in the alluvial aquifer along Hurricane Creek moving from the Franklin Power Products facility towards the Webb well field? | Yes, probably. | Both the flow modeling and the transport modeling support the conclusion that the cis-1,2 DCE contamination in well # 3 is from the FPP site. While the rate of movement and the details of the source term are not known, it is clear that the spills at the FPP site are polluting the Franklin community water supply wells. If our interpretation of the well logs and other already published data is correct, the creek has substantial hydraulic resistance and groundwater flow moves from the site to the well field. |
| If contaminated groundwater can move to the well field, how long would it take to arrive? | 7 - 30 years | The modeling indicates that the groundwater moving in the Hurricane Creek aquifer moves from the potential source to the well in about 9 years. The arrival of the peak contaminant concentration is delayed by sorption on to the aquifer matrix. |
| Are there other *potential* sources of contaminants in the area which could be responsible for the observed DCE in well #3? | Yes. | Circumstantial evidence points strongly towards the FPP site as the source. None of the potential sources has any documented releases to the groundwater. |
| What engineering response is required to prevent further contamination of the public water supply? | • Reduced pumping from the well field<br>• Intensive monitoring<br>• Wellhead protection planning | In order to protect the water supply it may be necessary to turn off the wells on the northwest side of Hurricane Creek. This could reduce the contamination at the well field but other drinking water supplies would have to be brought on-line to replace this capacity. The frequency of water quality monitoring should be increased, especially during the months when pumping rates are highest (summer). Wellhead protection should begin to involve the community in the decisions about well field management and long-term water resource protection |

## *Literature Cited*


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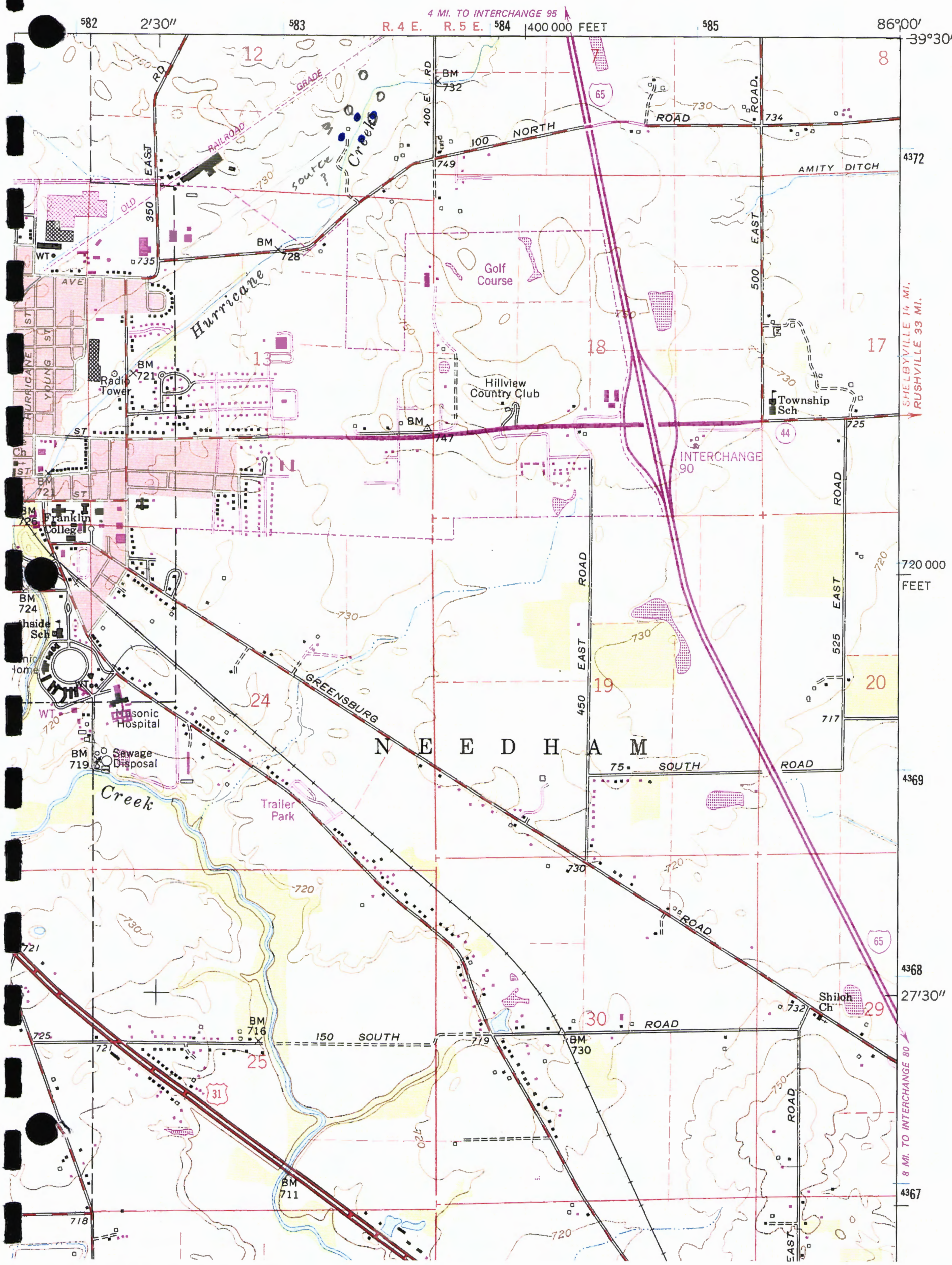
# FIGURES

Figure 1. Location of the Webb well field near Franklin.

FRANKLIN QUADRANGLE
INDIANA–JOHNSON CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



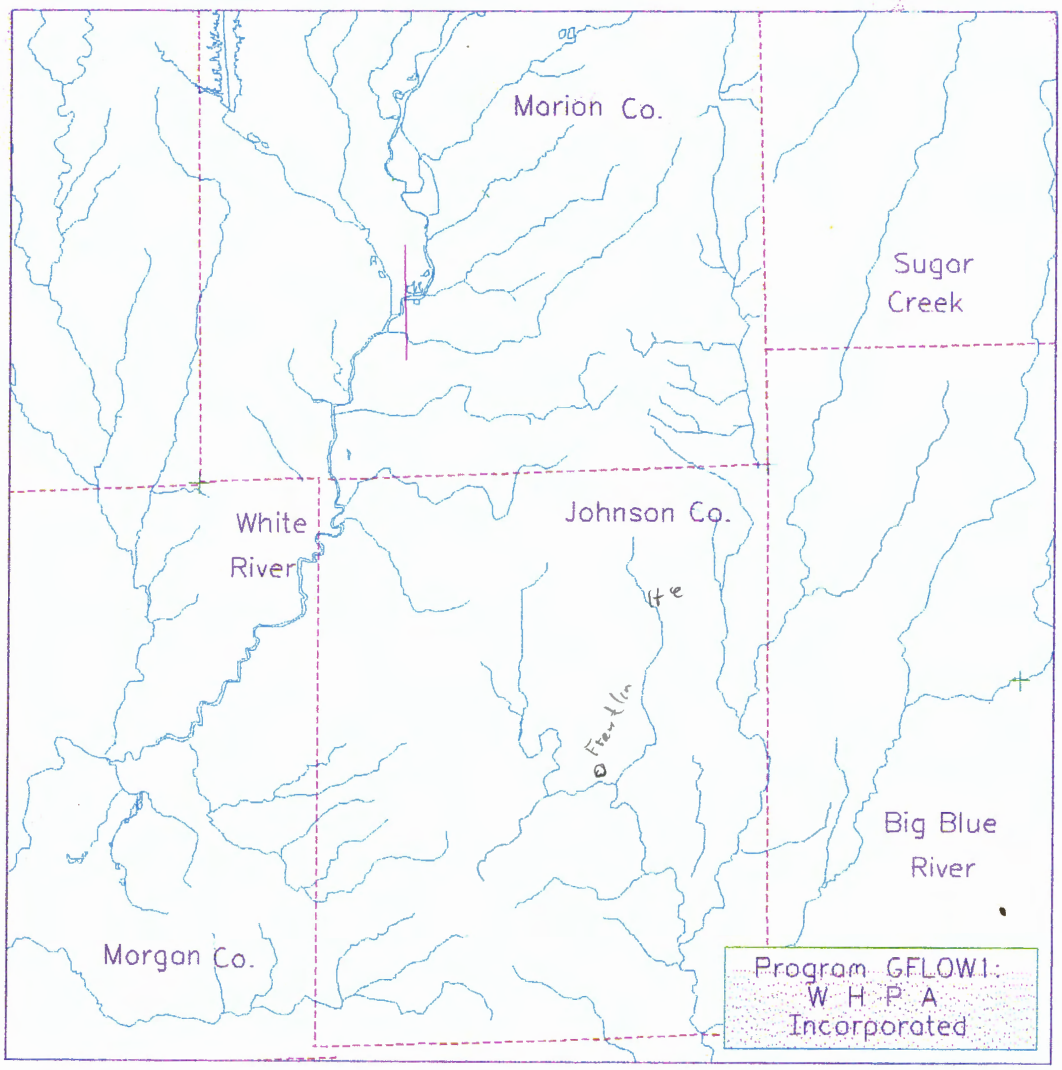



Figure 2. Drainage features in the region surrounding Johnson County.

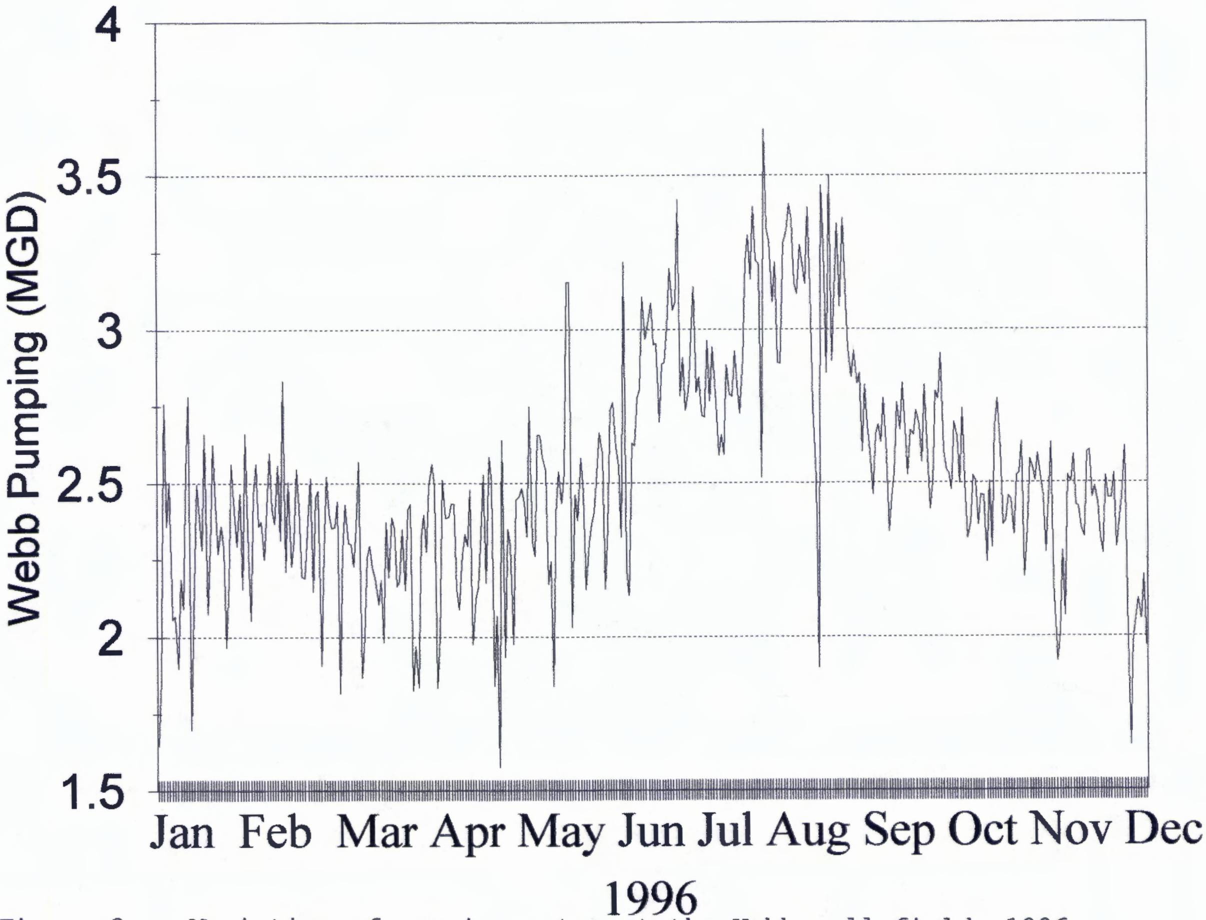


Figure 3. Variation of pumping rates at the Webb well field, 1996.

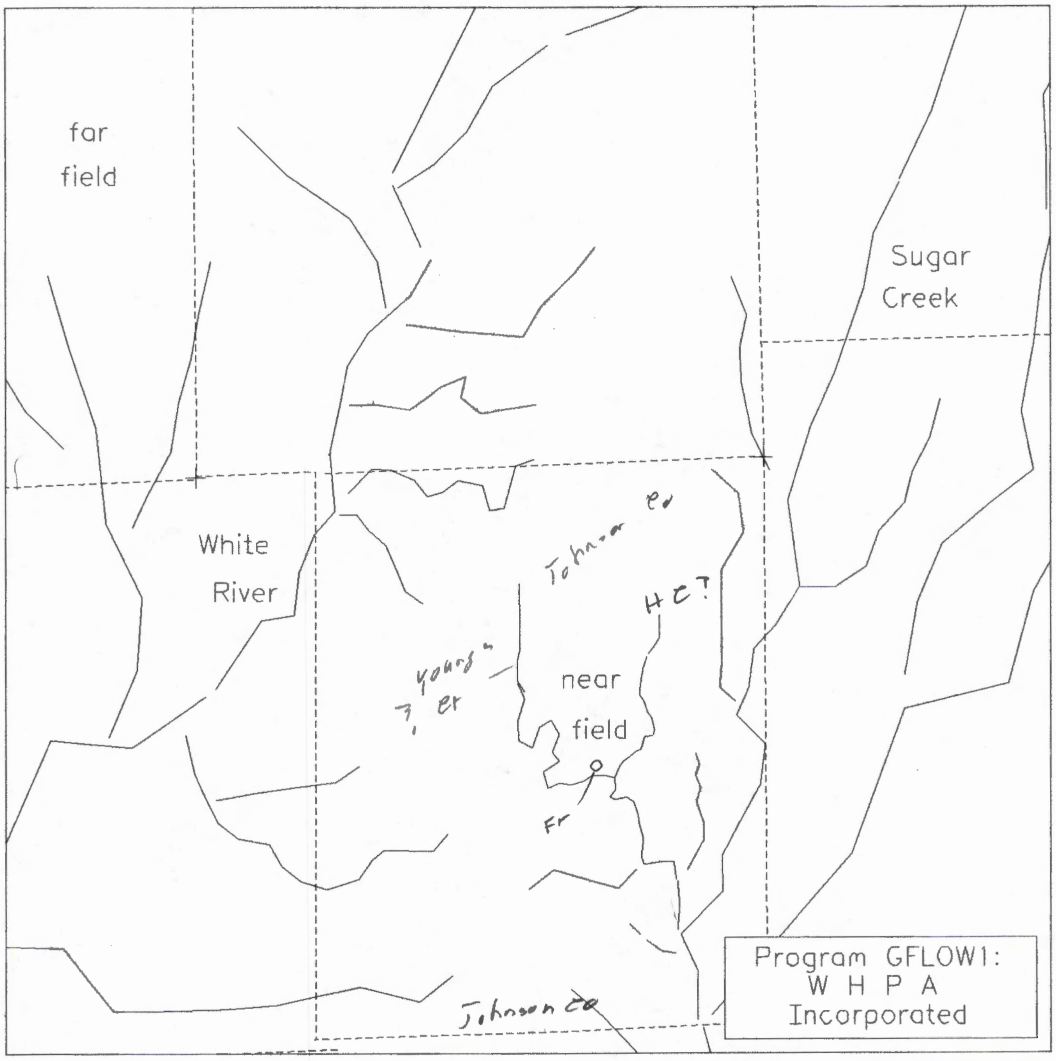



Figure 4. Layout of line sinks in the modeled region. Note the decreasing length of the line sinks in the vicinity of Hurricane Creek.

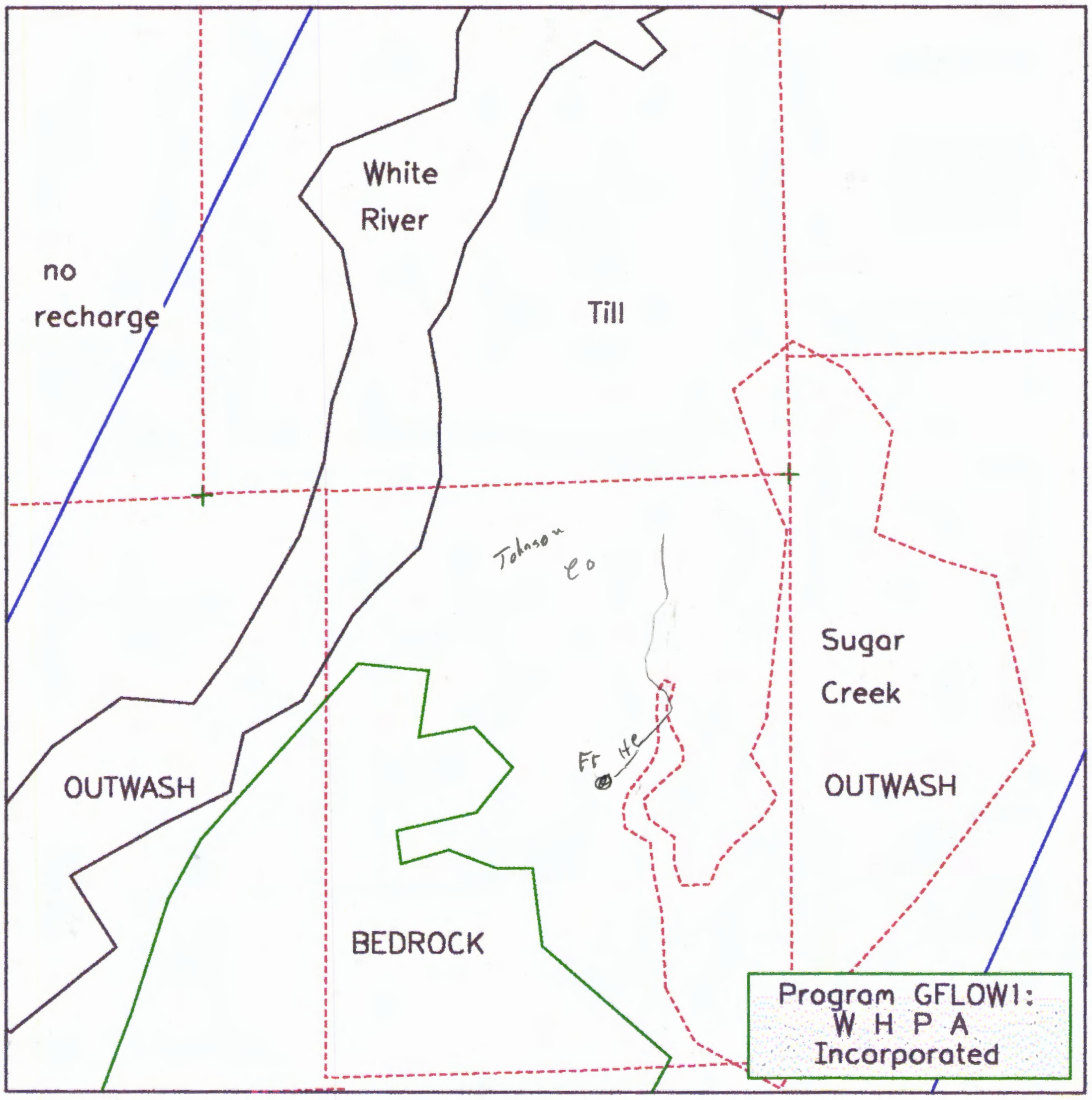



Figure 5. Layout of the inhomogeneities used to model the important differences in aquifer properties.

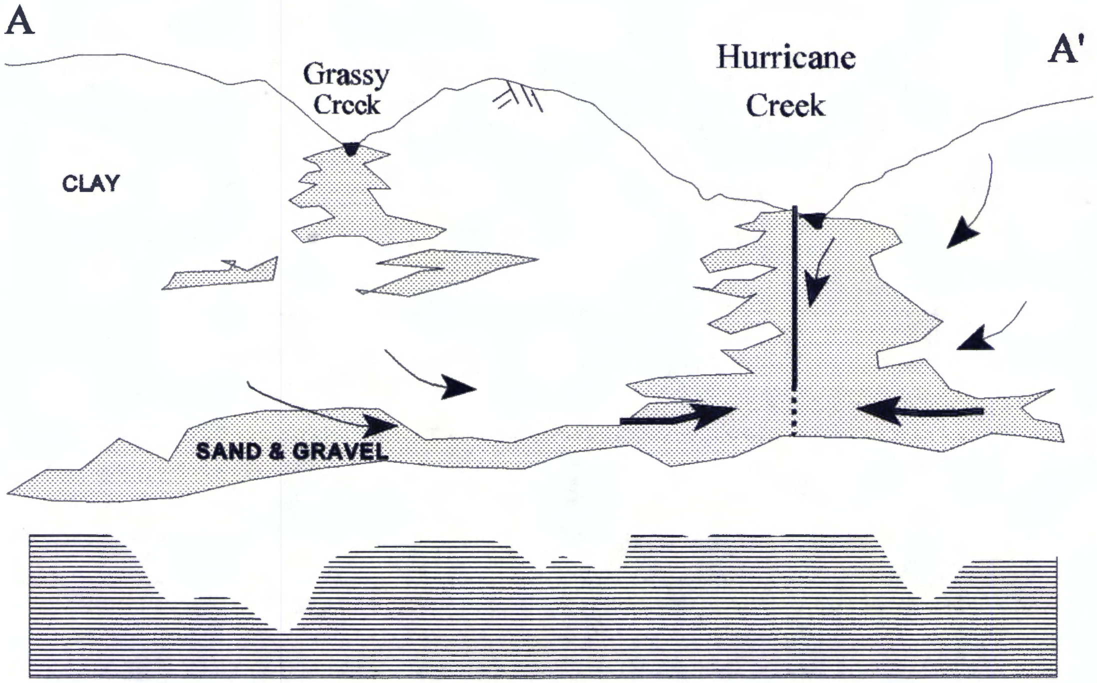



Figure 6. Conceptual geologic east-west cross section in the study area.

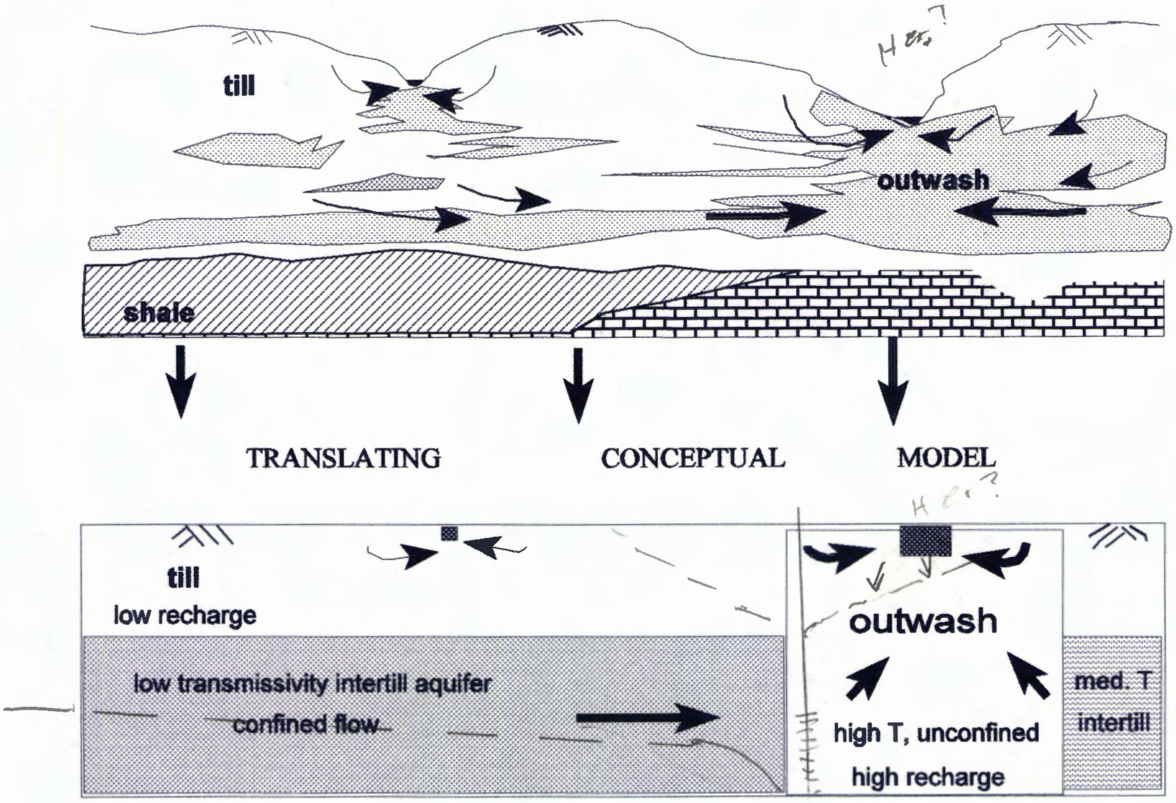



Figure 7. A diagram indicating the process of translating the geologic information into a conceptual model.

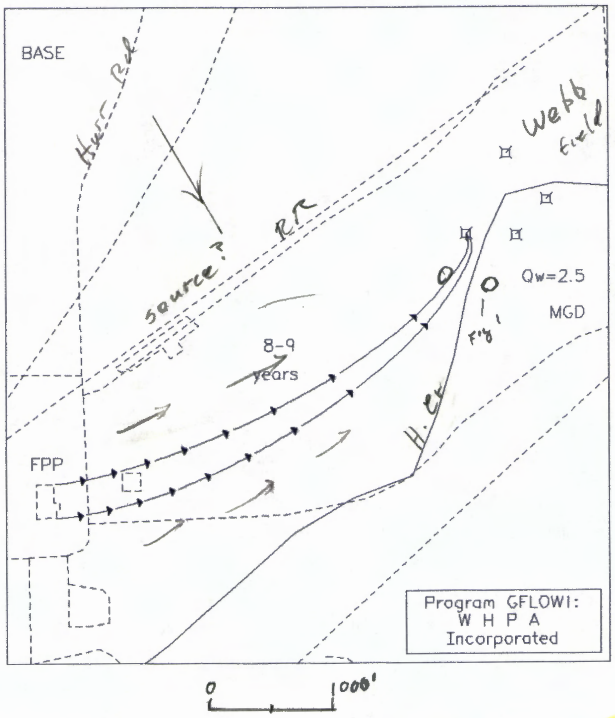



Figure 8.    Modeled pathlines from the FPP site: Base case.

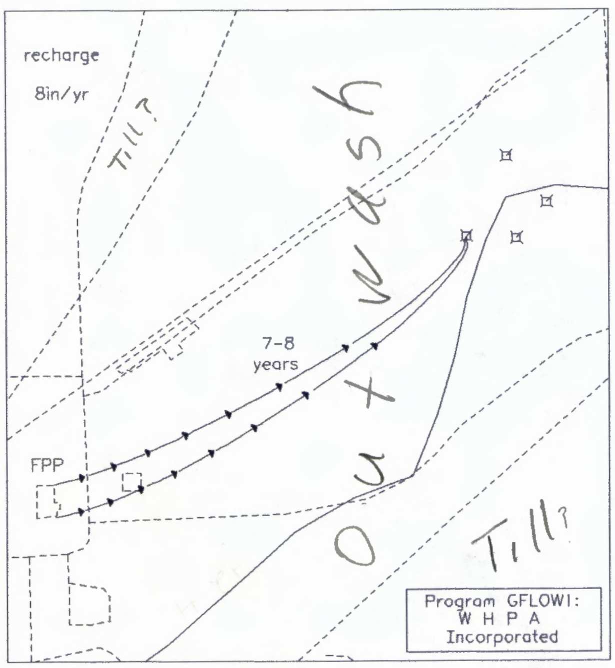



Figure 9.    Modeled pathlines from the FPP site: recharge 8 in/yr.

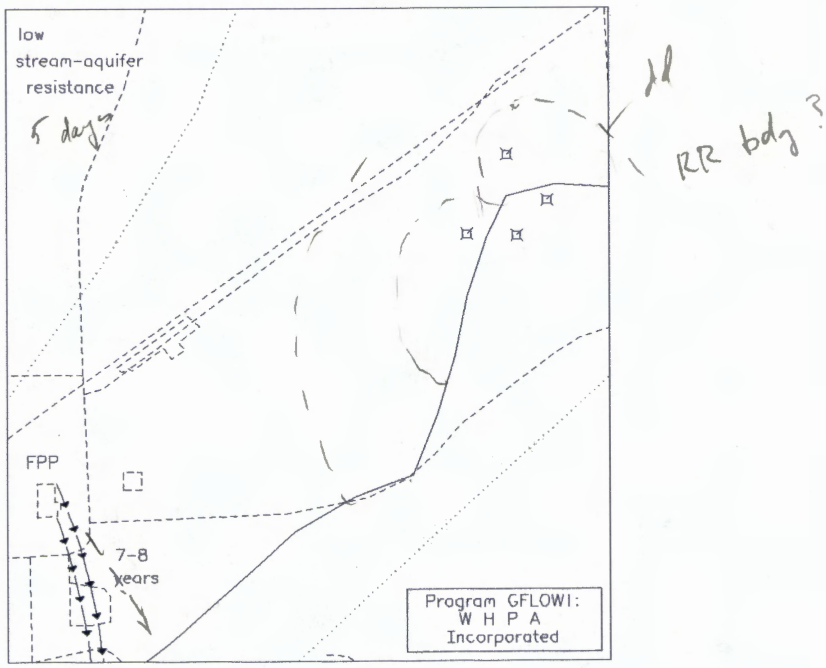



Figure 10. Modeled pathlines from the FPP site: low stream/aquifer resistance (5 days).

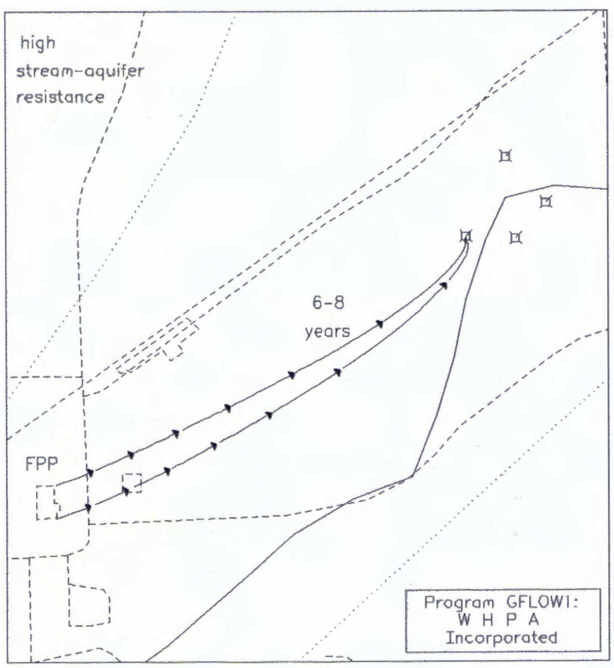



Figure 11. Modeled pathlines from the FPP site: high stream/aquifer resistance (50 days).

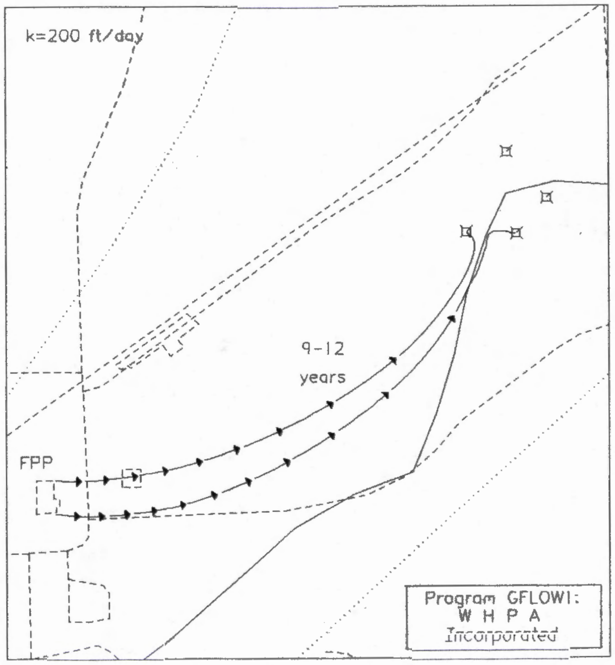



Figure 12. Modeled pathlines from the FPP site: high hydraulic conductivity (k = 200 ft/day).

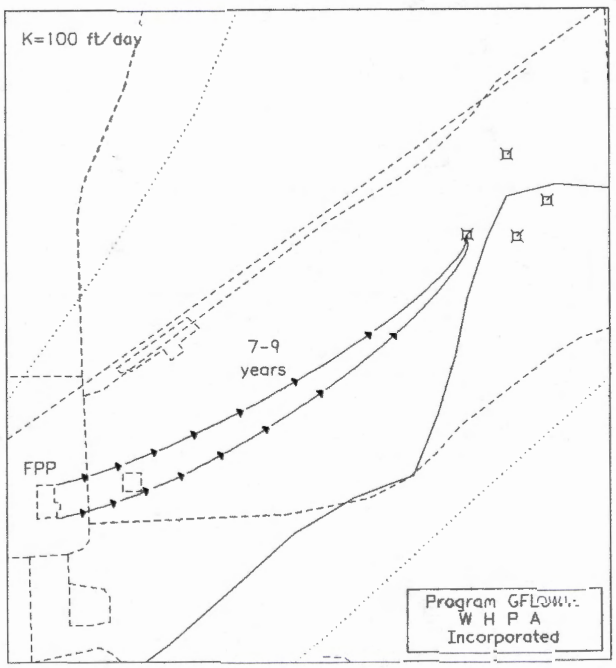



Figure 13. Modeled pathlines from the FPP site: low hydraulic conductivity (k = 100 ft/day).

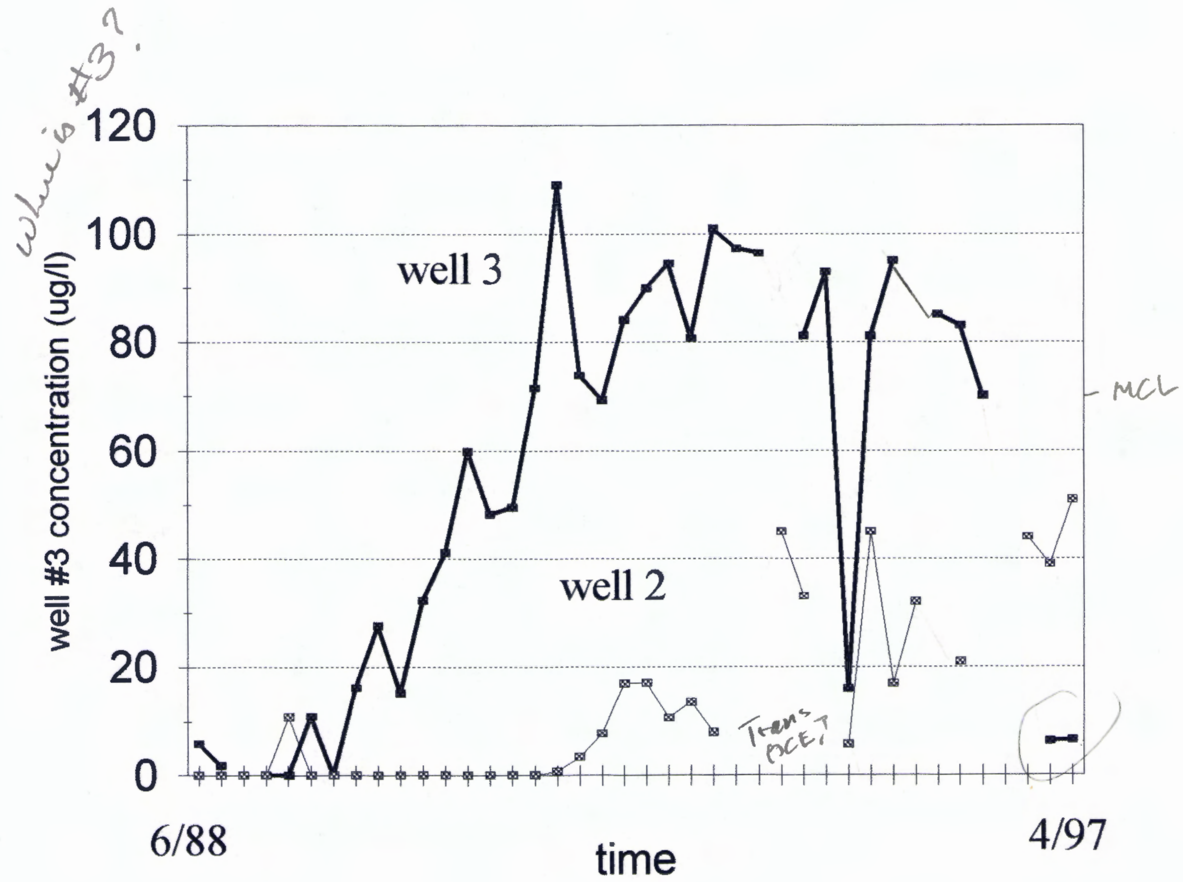



Figure 14. Observed concentrations of DCE in well #3.

Attachment 1

# EPA Statement of Basis

STATEMENT OF BASIS

FOR

FRANKLIN POWER PRODUCTS/AMPHENOL FACILITY
FRANKLIN, INDIANA
IND 044 587 848

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
(U.S. EPA)

STATEMENT OF BASIS

Franklin Power Products/Amphenol Facility
Franklin, Indiana
IND 044 587 848

## INTRODUCTION

This Statement of Basis for the Franklin Power Products/Amphenol (FPP/Amphenol) facility discusses several viable remedies for site remediation and explains the remedy proposed by the United States Environmental Protection Agency (U.S.EPA) to clean up the site. U.S. EPA will select a final remedy for the facility only after the public comment period has ended and the information submitted by the public has been reviewed and considered.

This Statement of Basis is being issued by U.S. EPA as part of its public participation responsibilities under the Resource Conservation and Recovery Act (RCRA). This Statement of Basis summarizes information that can be found in greater detail in the final RCRA Facility Investigation (RFI) and Corrective Measures Study (CMS) reports and other pertinent documents contained in the Administrative Record for this facility. U.S. EPA and the State of Indiana encourage the public to review these documents in order to gain a more comprehensive understanding of the facility and the activities that have been conducted under the authority of RCRA.

U.S. EPA may modify the proposed remedy or select another remedy based on public comments or new information obtained. Therefore the public is encouraged to review and comment on the alternatives proposed. If a public meeting is requested, U.S. EPA will publish a newspaper notice of the meeting prior to the meeting date.

## PROPOSED REMEDY

U.S. EPA proposes the removal of contaminated groundwater by an on-site groundwater recovery system, treatment of the recovered water and discharge to the City of Franklin sanitary sewer/water treatment system, and additional remediation of soil and groundwater by an on-site air sparging/soil vapor extraction (SVE) system. The proposed remedy includes enactment of institutional controls to prevent contact with contaminants, and enactment of environmental monitoring programs to assess the effectiveness of the remedy implementation.

## FACILITY BACKGROUND

The FPP/Amphenol facility consists of 15 acres and is located in the north east part of the city of Franklin, Indiana. The facility is bounded on the east by Hurricane road, on the south by Hamilton Avenue, on the north by an abandoned railroad, and on the west by industrial/commercial properties. Hurricane Creek, which lies about 1/4 mile south of the facility and drains to Youngs Creek, is the nearest surface water body. The location of the facility is shown in Figure 1 (see Attachment A - Figures).

The facility was built in 1961 by Dage electric and acquired by Bendix in 1963. After operations at the facility ceased in 1983 several acquisitions/mergers occurred. The facility was eventually acquired by Amphenol Corporation and sold to Franklin, Power Products, Inc. in 1989, the current owner and operator of the facility.

### Facility Operations and Waste Handling

Past operations at the facility included degreasing, plating, metal working and painting. The following hazardous wastes were handled at the facility:

(1) spent halogenated solvents including tetrachloroethylene, trichloroethane, methylene chloride, carbon tetrachloride used in degreasing operations, and chlorinated fluorocarbon and sludges from the recovery of the solvents;

(2) spent non-halogenated solvents including toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, and the still bottoms from the recovery of these solvents;

(3) waste water treatment sludges from electroplating operations;

(4) spent cyanide plating bath solutions from electroplating operations;

Areas where hazardous materials were stored:

(1) an above-ground 500 gallon tank for trichloroethane storage and drum storage area at west central side of plant building;

(2) a chemical container storage room along the southwest side of the building;

(3) an above-ground 500 gallon tank for trichloroethene storage and a 1000 gallon tank for hydrochloric acid storage;

(4) a 1000 gallon in-ground concrete overflow vault for cyanide storage.

## Previous Investigations and Remedial Activities

Investigations and remedial activities were performed at the facility in 1984 and 1985. The investigative activities included borehole drilling and monitoring well installation, and sampling/analysis of soil and ground water. This investigation revealed that a faulty drainage system at the plating room located at the southwest corner of the plant building had caused contaminant releases at the plating room. The investigation also revealed that significant contaminant releases had occurred at the facility sanitary sewer line leading to the main sewer line at Hamilton Avenue. Inspection by video camera of the sewer revealed numerous separated joints and crushed tile about 175 feet north of Hamilton Avenue. Further inspection also revealed that the sanitary sewer manhole at the corner of Hamilton Avenue and Forsythe Street was severely damaged.

Remedial activities in 1985 included removal of the plating room floor and underlying soil containing cyanide and solvent constituents. Soil exceeding 10 parts per million (ppm) of cyanide was removed and disposed in a RCRA permitted landfill. The damaged sanitary sewer on the property was also replaced with a new sewer line. The new line was offset 35 feet to the east of the old sewer line which was left in place. Additional remedial activities included drainage and decontamination of the plant waste water treatment system and plating room tanks. The underground cyanide overflow tank was drained and decontaminated and the pipes capped at the discharge ends. Twelve monitoring wells believed to be improperly constructed were removed and the boreholes grouted. The damaged sewer manhole at Forsythe and Hamilton was also repaired.

A six foot diameter storm sewer that transects the facility is a significant drainage feature at the site. The storm sewer captures drainage north of the facility becoming an underground culvert at the northwest corner of the facility and extending along the entire western property boundary, turning 90 degrees eastward at the southwest corner of the property and extending across the southern part of the facility, and ultimately discharging to Hurricane Creek through a 200 foot open channel.

## RCRA FACILITY INVESTIGATION (RFI)

The RFI, the investigative activities performed under the authority of RCRA, included a soil gas survey, analysis of borehole soil samples, installation and sampling/analysis of monitoring wells, sampling/analysis of surface water, and measurement of static water levels in the monitoring wells. Soil samples were collected at areas of known and suspected releases, and at locations not impacted by facility operations to provide background concentration levels. The RFI data was collected over the period extending from 1992 to 1996 and provided the data base for describing the site geology/hydrology and the extent and degree of contamination in soils and groundwater at the site.

Four distinct strata, Units A,B,C, and D (in descending order), comprise the upper geologic strata at the site. Unit A, averaging in thickness of about 5 feet, forms the surficial soil layer. Unit B, comprised of silty/sandy material ranging in thickness from 5 to 20 feet, forms the shallow aquifer at the site. Unit C, a dense compacted unit about 25 feet thick, yields minimal amounts of water and acts as a semi-confining layer or aquitard between Unit B and Unit D. Unit D is a sandy layer about 20 feet thick that forms a lower aquifer. Unit D is underlain by shale.

Unit B under normal hydrologic conditions is only partially saturated with water forming a shallow water table (top of the saturated zone) in the aquifer. Groundwater water data indicate groundwater flow (seepage) is southward (downgradient) towards Hurricane Creek.

Sample analytical results shows that significant soil and groundwater contamination exists on-site (on facility property), and to a lesser extent, off-site. The principal constituents of concern are chlorinated hydrocarbon compounds which were used as solvents at the facility. These compounds have a high degree of volatility and are commonly referred to as volatile organic compounds (VOC)s. The principal VOCs found at the site are tetrachloroethene (PCE), trichloroethene (TCE), trichoroethane (TCA) and dichloroethane (DCA). Due to natural biodegration mechanisms, PCE, which is the most highly chlorinated compound and termed the "parent compound", may be striped of chloride to form "daughter compounds", which maybe further stripped of chloride. Daughter compounds such as TCE, and DCA, may also enter the environment directly from spillage.

Soil Contamination

Soils were sampled and analyzed for VOCs, cyanide and metal constituents. The data indicates that the degree of VOC soil contamination differs considerably for depths above and below the seasonably fluctuating water table. At depths above the water table, (less than 12 feet) VOC soil contamination is mostly restricted to on site areas with concentrations as high as 1080 micrograms per kilogram (ug/kg). A ug/kg is equivalent to one part per billion. However, due to the movement of contaminated groundwater and soil-water interaction, at depths below the water table (over 12 feet), soil contamination is more widely dispersed and extends off-site. The highest total VOC concentration of 127,800 ug/kg was found near the old sanitary sewer line. PCE is the principal VOC constituent in soils at the facility. The distribution of total VOCs in soils at the site is shown in Sheets 5A and 5B of the RFI report titled "Report of RCRA Facility Investigation Activities at the Former Amphenol Site, Franklin, Indiana, Volume 1". The VOC distribution is depicted by concentration contour lines which represent equal lines of VOC concentration in the soil as inferred from the available data.

Due to the physical and chemical characteristics of the VOCs found at the site (low miscibility with water and a specific gravity greater than water), there is a potential for these chemicals to exist as separate phase liquids in the subsurface. Such liquids are referred to as dense non-aqueous phase liquids. Each monitoring well was tested for non-aqueous phase liquids by a special sensing probe; the testing did not identify any such liquids in the subsurface. However, the high soil and groundwater VOC concentrations near the sanitary sewer suggest that the such separate liquids, though probably occurring only in small discrete amounts or droplets rather than distinct pools, may exist to some extent in the subsurface.

At Forsythe Street, where contaminants were apparently released by the sanitary sewer line under the street, VOC concentrations in soils are much lower than levels at the facility property. PCE with a concentration of 37 ug/kg was the highest VOC detected.

The highest cyanide concentration in soils sampled during the RFI investigation was 21.6 milligrams per kilogram (mg/kg). As noted in the Risk Summary section of this document, this concentration level does not exceed base line protection standards established by U.S. EPA. At Forsythe Street the highest cyanide concentration in soils was 1.5 mg/kg. Data indicates that metal concentrations at release areas are similar to background concentrations, and do not exhibit a statistically significant difference when compared to background concentrations.

*Groundwater Contamination*

Samples of groundwater were collected from monitoring wells and also through the geoprobe sampling device. Geoprobe sampling, which is accomplished by forcing a truck mounted small diameter sampling device through the soil, is a relatively non-invasive sampling procedure and was used primarily for off-site locations. The groundwater samples were analyzed for the Appendix IX (40 CFR 264) list of VOCs and semi-volatile analytes (organo-chlorine pesticides excluded), metal constituents, and cyanide.

Analytical results of groundwater samples indicate that the contamination is restricted to the shallow aquifer, Unit B, and consists primarily of VOCs leached from overlying soils. The extent of VOC concentration distribution as defined in March, 1993 is shown in Sheets 6A, 6B, 6C, 6D and 6E of Volume 1 of the RFI report. Sheets 6A-6D show the concentrations for the individual VOC constituents DCA, PCE, TCA, and TCE, and Sheet 6E shows the total VOC concentration distribution. Total VOC concentrations in groundwater sampled in 1993 were as high as 21,000 micrograms per liter (ug/l)[a ug/l is equivalent to one part per billion]. The configuration of the groundwater contaminant plume suggests that the storm sewer transecting the southern part of the facility has provided some control on the contaminant plume. During wetter hydrologic conditions, the water table is above the base of the storm sewer and contaminated groundwater seeps into the sewer through breaks in the line. The contaminated groundwater intercepted by the storm sewer is discharged to Hurricane Creek.

Groundwater data collected at Forsythe Street, though limited due to the off-site location, indicate that VOC contaminated groundwater occurs in a relatively narrow band in Unit B, extending from Hamilton Avenue to a few hundred feet south of Ross court. Total VOCs in samples collected by the geoprobe sampling method were as high as 1950 ug/l in geoprobe samples collected at Forsythe Street in 1993. VOC concentrations in samples collected in April, 1996 from recently constructed monitoring wells were considerably lower; the highest total VOC concentration was 245 ug/l. The VOC concentration distribution near Forsythe Street as defined in April 1996 is illustrated in the report titled "Report of Additional Corrective Measures Studies for the Former Amphenol Facility Franklin, Indiana"; Sheets 3A, 3B, 3C, 3D show the individual VOC constituent concentrations in groundwater, and sheet 3E shows the total VOC concentrations.

Cyanide concentrations in groundwater samples collected at the site did not exceed the analytical detection limits of 0.010 milligrams per liter (mg/l) and are below drinking water standards. Though some metal constituents in groundwater exceeded the standards for drinking water, the constituents were also found in up gradient wells (background levels). Also, comparison of filtered to unfiltered sample results suggest that the higher concentration levels may be attributed to suspended solids (native soil material) in the sample.

Since there is a potential for the contaminated storm sewer to infiltrate the aquifer near the disharge point at Hurricane Creek, groundwater samples were collected near the sewer outfall and at a downstream sampling point, and a soil sample was collected at a further downstream location. No VOCs were detected in these samples indicating there has been minimal impact to groundwater by the storm sewer. ("Report of Shallow Groundwater Sampling Along Hurricane Creek - November, 1996).

Surface Water and Sediment

To evaluate the impact of the storm sewer discharge on surface water and sediment in Hurricane Creek, water and sediment samples were collected at strategic points and analyzed for VOCs, metals, and cyanide. Analytical results of the sediment samples show that metal concentrations downstream of the discharge point and at the outfall of the sewer are consistent with concentrations at upstream and infall locations. The VOC data and overall impact to Hurricane Creek is discussed in the Ecologic Risk Assessment segment of this Statement of Basis.

Sampling was not conducted along the storm sewer line portion downstream of facility property extending to the outfall. Contamination at this part of the sewer line is not expected since groundwater normally seeps into the sewer line rather than sewer water infiltrating to the groundwater.

RISK SUMMARY

To quantify the risk to human health and the environment imposed by the contaminants at the site, risk assessments were performed for chemicals of concern in soil and groundwater media. Risk resulting from carcinogenic compounds (cancer causing) is expressed as a probability; a risk quantified as 1E-06 is defined as a risk level at which one additional person in one million would develop cancer due to exposure to the compound or group of compounds. Non-carcinogenic risks are expressed as a hazard quotient or hazard indice, with the sum of the hazard quotients representing the total hazard. U.S. EPA generally recognizes a carcinogenic risk of less than 1E-06 as acceptable and not requiring corrective action, whereas carcinogenic risks between 1E-04 (1 in 10,000) and 1E-06 are closely scrutinized in the decision process. A total hazard below 1.0 is recognized as an acceptable non-carcinogenic risk.

As a means to streamline the risk assessment process, soil screening levels (SSL)s are also used by U.S. EPA in the assessment process. SSLs are conservative risk based concentration levels established by U.S. EPA (1996), which if not exceeded for a single constituent, the risk is deemed to be acceptable and soil remediation for the constituent is not required. Since different SSLs are provided for ingestion, inhalation, and potential migration to groundwater exposure routes, the lowest of the SSL value for a constituent must not be exceeded to screen out the constituent. It should be noted that SSLs are used as a screening tool; exceedence of a SSL does not necessarily call for remediation, rather it indicates that the level of contamination needs a more detailed evaluation.

No sensitive populations (schools, hospitals, or nursing homes) were identified as potential receptors to site contaminants.

Soils - Inorganic Constituents

The results of a risk evaluation for inorganic soil constituents are presented in the document "Risk Evaluation for Inorganic Constituents", U.S. EPA 1996, and are summarized below.

A risk evaluation based on a residential land use projection and incorporating ingestion, dermal, and inhalation exposure routes was performed for 24 inorganic soil constituents, all of which may occur naturally in soils. The risk calculations were developed for constituent concentrations in soil samples collected at locations where contaminant releases had occurred or expected to have occurred at the facility (site risks), and also for constituent concentrations in samples collected at locations not impacted by the facility (background risks). The site risks were then compared to the background risks to evaluate the risk posed by the inorganic constituents evaluated. The results of the risk evaluation are presented in Table 4 (see Attachment B - tables).

For risk calculations in which maximum concentrations were applied (Reasonable Maximum Exposure), the site-related total risk for adults was 2E-05 (2 out of 100,000) and the total hazard was 0.4, as compared to the adult background risk of 1E-05 and total hazard of 0.1. For a child, the site-related total risk was 3E-05 and total hazard was 1.0, as compared to a background total risk of 2E-05 and total hazard of 0.6.

For calculations in which average concentrations were applied (central tendency values), the site risk for adults was 8E-07 (8 out of 10 million) and total hazard was 0.04; whereas the adult background total risk was 1E-06 and total hazard was 0.04. For a child, the site-related total risk was 4E-06 and total hazard was 0.2; as compared to a background total risk of 6E-06 and total hazard of 0.2.

The excess risk, which is defined as a risk greater than 1E-06, is attributed to arsenic and beryllium concentrations in the soil. However, the comparative risk results show there is little difference in site related risk and background risk, in fact the central tendency risks for background were slightly higher than the central tendency site-related risks. It is also noted that the risk calculations were based on a residential land use scenario even though it is likely the facility will remain under industrial use over the long term. Human exposure to contaminants at industrial sites is considerably less than at residential sites. Also, a statistical analysis demonstrated that there were no significant statistical differences between site-related and background concentrations of metals in soils.

Cyanide concentrations in soils were well below SSLs based on the ingestion exposure route and were not detected in groundwater.

<u>Soils - Organic constituents</u>

PCE, TCE, and TCA concentrations exceeded SSLs at the more highly impacted areas. PCE, with a high end concentration of 120,000 ug/kg exceeded the SSLs for ingestion, inhalation, and migration to groundwater of 12,000 ug/kg, 11,000 ug/kg, and 3 ug/kg respectively. Since the VOCs occur at considerable depth, the exceedance of conservative SSLs does not suggest that ingestion or inhalation of VOCs at the site pose an immediate health risk.

At Forsythe Street VOC levels in soils are much lower, the only compound exceeding SSLs was TCE (37 ug/kg, SSL for groundwater = 3 ug/kg).

<u>Groundwater</u>

VOC concentrations in groundwater at the site, both on-site and off-site, exceed Drinking Water Standards. Drinking water standards generally serve as a benchmark in decision making for groundwater remediation. Wide spread contamination and exceedance of standards in most cases requires cleanup for restoration of the groundwater.

<u>In-door air risk</u>

VOCs contained in groundwater and soil tend to volatilize, move upward through the soil and discharge to the air. In situations where housing directly overlies VOC contamination, there is a potential for VOCs to enter the homes with the greatest potential for accumulation in basements. A risk evaluation was performed by U.S. EPA to evaluate the indoor air risk at residential homes. The results of the risk evaluation are provided in the document "Franklin Power Products/Amphenol Franklin, Indiana-Indoor Air Risk Evaluation" - U.S. EPA, 1996, and summarized below.

The risk evaluation entailed a series of calculations in which different values of residential air exchange rates, soil permeabilities, and inhalation rates were applied. VOC contamination at residential areas is primarily due to transport by groundwater movement, consequently groundwater would be the primary source for VOCs in homes. The representative groundwater source concentrations, extrapolated from a 1996 sampling/analysis of a monitoring well at Forsythe Street (MW-31), was held constant in the calculations.

The results of the calculations showed a total cancer risk ranging from 5E-07 (5 per 10 million) to 9E-06 (9 per 1 million) for an adult; and 3E-07 to 6E-06 for a child. The hazard indices (total hazard in this case) for child and adult ranged from 0.00004 to 0.002 which are well below the acceptable level of 1. The uncertainty discussion in the risk report notes that all the parameter inputs to the risk calculations are conservative in nature thereby tending to overstate the risk. It is also noted that the groundwater concentration value which was held constant, in actuality will very likely decrease over the 30 year exposure period applied thereby further reducing the risk. The risk evaluation indicates that the risk imposed by indoor air is below 1E-05, and considering the conservative assumptions of the evaluation, very likely below 1E-06 and at acceptable levels.

Ecological Risk

Soil and groundwater contamination at the site is mostly confined to the subsurface, the only ecological receptors expected at the site is at Hurricane Creek near the storm sewer discharge. A qualitative risk assessment was performed to evaluate the impact to ecosystems in Hurricane Creek. Populations potentially impacted include small fish species, crayfish, and aquatic macro invertebrates. Concentrations of VOCs in the storm sewer discharge water were compared to the Lowest Observed Effect Levels (LOEL) established by U.S. EPA. The LOELs are maximum levels at which no adverse affect to a population is observed. This comparison revealed only one incident when these levels were exceeded. In May 1986 the PCE concentration of 1500 ug/l at the sewer outfall exceeded the LOEL level of 840 ug/l. Data indicates that contaminant concentrations in the storm drain are decreasing over time.

The risk to humans through contact with VOCs, primarily children wading the creek, was calculated to be 1E-07.

## SCOPE OF CORRECTIVE ACTION

### Interim Corrective Measures

Several corrective measures have been implemented to provide immediate protection of Human Health and the Environment at the site. In response to an October 28, 1992, inquiry by the Johnson County Health Department, two private wells located in the potentially impacted area were identified, but these wells were not used as a drinking water source. Residents in the potentially impacted area are supplied by a commercial water supply system which draws water from wells located upgradient of the facility.

A groundwater recovery system consisting of three on site recovery wells and a groundwater treatment system became operational in February 1995. The treatment system removes VOCs through an air stripping process and the treated water is discharged to the Franklin sewer system as permitted by the city. The VOCs stripped from the groundwater are discharged to the atmosphere at a rate below that requiring a permit by the State of Indiana.

## SUMMARY OF ALTERNATIVES

The Corrective Measures Report developed by FPP/Amphenol partitioned the site into three operable areas (Operable Areas 1,2, and 3) for evaluation of alternative remedies. The three operable areas are delineated in Figure 5-1 (see Attachment A). Operable Area 1 is the impacted area lying within the facility property boundary; Operable Area 2 is the area adjacent to the storm drain; and Operable Area 3 is the contaminated area at Forsythe street and Hamilton Avenue. Six principal alternatives actions were discussed in the CMS Report.

Alternative 1 - No Action
This alternative was provided as a basis for comparison for the

other alternatives. No cost incurred.

Alternative 2 - Institutional Controls; and Monitoring.
This Alternative includes enactment of institutional controls by the following means: a deed restriction for the facility limiting access to soils and groundwater at the facility; restriction of water well drilling permits; and advisories for confined space entry to the storm and sanitary sewer manholes. Monitoring includes semi-annual sampling/analysis of on-site and off-site monitoring wells, annual soil analysis or soil gas monitoring, and sampling/analysis of storm sewer water. The institutional and monitoring elements of this alternative apply to all subsequent alternatives discussed.

Costs

| | |
|---|---|
| Capital - | $ 24,000 |
| 5 years of operation | 85,000 |
| Total | 109,000 |

Alternative 2A - Alternative incorporates the corrective measures of Alternate 2 and includes groundwater extraction by continued operation of the existing on-site groundwater recovery system.

Costs

| | |
|---|---|
| Capital | $ 24,000 |
| 5 years of operation | 300,000 |
| Total | 324,000 |

Alternative 3 - Institutional Controls; monitoring; groundwater extraction; and sparge/soil vapor extraction.
This Alternative incorporates operation of the existing groundwater recovery system and includes a groundwater sparging and soil vapor extraction system (SVE) installed at on-site locations to remediate impacted groundwater and soils. Operation of a sparge/SVE system involves injecting air to the aquifer by sparge wells to enhance the volatilization of the VOCs in groundwater. SVE wells located near the sparge wells withdraw the VOC gas created by the sparging. Operation of a sparge/SVE system may also cause significant removal of VOCs in the unsaturated soil zone overlying the water table.

The sparge/SVE system consists of an east-west row of sparging and SVE wells located near the southern boundary of the facility, and a double row of sparge and SVE wells located near the old sanitary sewer. The configuration of this sparge/SVE system is attached and identified as Figure 5-4. A structure to accommodate SVE system equipment would be located adjacent to the existing groundwater treatment system.

Costs

| | |
|---|---|
| Capital | $182,000 |
| 5 years operation | 505,000 |
| Total | 687,000 |

Alternative 4 - Institutional controls; monitoring; groundwater extraction; and soil excavation with aeration and backfilling. This Alternative includes operation of the recovery system and excavation of severely impacted soils near the old sanitary sewer. An area extending about 25 by 50 feet is proposed for excavation. The contaminated soils would be placed on-site in windrows and aerated by tilling. Following sufficient reduction of contaminants, the excavated area would be backfilled with the treated soil. Excavation likely would extend below the water table requiring dewatering and treatment of the pumped groundwater.

Costs

| | |
|---|---|
| Capital | $125,000 |
| 5 years operation | 300,000 |
| Total | 425,000 |

Alternative 4A - Alternate 4 is modified by off-site disposal of contaminated soil instead of on-site treatment.

Costs

| | |
|---|---|
| Capital | $1,347,000 |
| 5 years operation | 300,000 |
| | 1,647,000 |

Alternative 5 - Institutional controls; monitoring; groundwater extraction; and focused sparging/SVE.
This Alternative incorporates groundwater recovery and a focused sparging/SVE system. The sparge/SVE system would be limited to the severely impacted area at the old sanitary sewer and have the same configuration as depicted in Figure 5-4. Treatment of off-gas from the SVE system would likely not be required because of the reduced amount of VOC gas generated.

Costs

| | |
|---|---|
| Capital | $119,000 |
| 5 years operation | 475,000 |
| Total | 594,000 |

Alternate 6 - Institutional controls; monitoring; groundwater water recovery with additional water treatment by carbon adsorption; and reinjection of treated water.
This Alternative incorporates groundwater recovery with

reinjection of the treated groundwater. If needed, water treatment would be enhanced by passing the water through a series of connected activated carbon cells so as to meet water quality requirements for reinjection. The treated groundwater would be injected through a network of wells, infiltration trenches, or ponds located up gradient of the contaminated area. The reinjection of treated water would promote flushing of soil contaminants which would eventually be captured by the recovery system. However, this Alternative would raise the water table thereby countering somewhat the recovery system's objective of lowering the water table at the storm sewer.

| Costs | |
|---|---|
| Capital | $ 72,000 |
| 5 years operation | 340,000 |
| Total | 412,000 |

Alternatives 2A through 6 propose monitoring as the remedial action for Operable Area 3. If data indicates a significant increase in contaminant concentration or migration, implementation of a groundwater recovery system for this operable area will be considered. The groundwater recovery system would be implemented by conversion of existing monitoring wells at Forsythe Street to recovery wells, and installation of a pipeline to transport the recovered water to the on-site treatment system. The remedy alternatives for Operable Area 3 are discussed in the supplemental CMS report "Report of Additional Corrective Measures Studies for the Former Amphenol Facility, Franklin, Indiana", November, 1996.

<u>Alternative Proposed by FPP/Amphenol</u> The alternative proposed by FPP/Amphenol to remediate the site is Alternative 5.

## EVALUATION OF THE ALTERNATIVES

In order to determine the most appropriate remediation for the facility, corrective measure alternatives are evaluated pursuant to the nine criteria presented below.

1. Short-Term Effectiveness - This criterion addresses the remedial alternative's effect on human health and the environment during the construction and implementation phase of the remedial action. Short-Term effectiveness is based on the following four factors:

- protection of community during remedial actions;
- protection of the workers during remedial actions;
- potential for adverse impacts on the environment due to

implementing the remedial action; and

- time required to meet the remedial response objectives.

2. Long-Term Reliability and Effectiveness - This evaluation criterion addresses the results of a remedial alternative in terms of the risks remaining to human health and the environment at the site after remediation goals have been met. The following factors characterize the potential risks remaining at the site following completion of the implementation:

- the magnitude of potential risk remaining due to treated waste of treatment residuals following the completion of the remedial alternative; and
- the adequacy and reliability of controls that are used to manage untreated wastes or treatment residuals remaining at the site.

3. Implementability - this criterion refers to the ease of implementation and the following factors are taken into consideration:

- ability to construct and operate the technology;
- reliability of the technology;
- ease of undertaking additional corrective measures if necessary;
- ability to monitor effectiveness of remedy;
- coordination with other agencies;
- availability of off-site treatment, storage and disposal services; and
- availability of prospective technologies.

4. Reduction of Mobility, Toxicity, or Volume of Wastes or Contaminants. This evaluation criterion assesses the level to which the remedial alternative reduces the potential toxicity, mobility, or volume of wastes or contaminants based on the following factors:

- treatment process used and materials treated;
- amount of hazardous materials destroyed or treated;
- degree of expected reductions in toxicity, mobility, or volume;
- degree to which treatment is irreversible; and
- type and quantity of residuals remaining after treatment.

5. Costs - The costs criteria assesses capital (construction) costs, operating and maintenance costs for 5 years, and total costs for capital and 5 years of operation.

6. Overall Protection of Human Health and the Environment - This criterion assesses how alternatives provide protection to human health and the environment.

7. Attain Media Cleanup Standards - this criterion assesses the alternatives ability to achieve the media cleanup standards prescribed in the enforcement order.

8. Control the Sources of Releases - This Criterion assesses the ability of alternatives to reduce or eliminate to the maximum extent possible further releases.

9. Comply with Standards for Management of Wastes - This criterion assesses how alternatives assure that management of wastes during corrective measures is conducted in a protective manner.

<u>Discussion of Corrective Measures Study Alternatives</u>

As noted previously, the CMS Report submitted by FPP/Amphenol delineated three separate operable areas (Operable Areas 1, 2, and 3) for evaluation of remedial alternatives. Data indicates that Operable Area 2, except the part of the area adjacent to Area 1, has had minimal impact. Since the six alternatives evaluated are applicable to a consolidated area comprised of Area 1 and adjacent part of Area 2, this consolidated area is discussed as a single operable area. A discussion of Alternatives applicable to Operable Area 3 (Forsythe Street and Hamilton Avenue) is provided at end of this segment.

1. Short term effectiveness
The implementation of Alternatives 3, 5, and 6, which requires well drilling and some construction activities, will not pose a risk to the community and workers greater than that normally incurred with these operations. Workers will be required to follow a health and safety plan. The implementation of these alternatives would not be expected to cause an adverse impact to the environment. However, implementation of Alternative 6 which involves reinjection, would require careful monitoring to ensure that the reinjection does not cause widening of the groundwater plume. Implementation of Alternatives 4 and 4A, which entail deep soil excavation, may pose a higher risk to construction workers than the other alternatives.

As to the time needed to achieve remedial objectives, Alternative 3, which includes the expanded sparging/SVE system and provides the most expansive remediation of the site will obtain overall remedial objectives in the least time.

2. Long term Reliability and Effectiveness
Alternatives 4, 4A, 5, and 6 will have minimal impact on the western portion of the facility, consequently these alternatives would leave a higher level of residual contamination at this part of the facility. Alternatives 4 and 4A, by removal of contaminated soil at the most severely impacted area near the sanitary sewer would result in the least residual contamination in this area, but would not provide significant contaminant reduction at the western portion of the facility. Alternative 3, which includes the expanded sparge/SVE system that extends to the western edge of the contaminated area, would leave the least overall residual contamination and provide the best control of contaminant migration and long term effectiveness.

3. Implementability
Alternative 1 which prescribes no action, Alternative 2 with institution controls and monitoring, and Alternative 2A, which adds the operation of the existing recovery system, do not pose any implementation difficulties. The sparge/SVE systems of Alternatives 3 and 5 can be readily installed. Alternatives 4 and 4A, which may require special construction features to maintain excavation side walls, presents greater implementation difficulties. Implementation of the reinjection system will require balancing groundwater withdrawal and reinjection to the aquifer and has considerable potential for operational problems. Though the sparge/SVE systems are expected to require considerable preliminary testing and development, Alternative 3 and 5 are considered to have a higher degree of Implementability than Alternatives 4, 4A and 6.

The reliability, availability, ease of which the corrective measure can be expanded, and the ability to monitor the results, are generally comparable for the technologies evaluated. Both sparge/SVE and recovery/treatment systems are widely applied technologies, can be expanded as space permits, and can be readily monitored to evaluate the effectiveness of the systems. The reinjection alternative may be less reliable in that injection wells may become clogged and pumping systems may breakdown. Providing that excavation walls are maintained, Alternative 4 and 4A would be highly reliable in that a major portion of contaminated soil would be eliminated.

4. Reduction of Mobility, Toxicity, or Volume of Wastes/Contaminants

The Alternatives are discussed in the context of their effectiveness in reducing the mobility, toxicity, or volume of hazardous waste constituents (contaminants) remaining in soils and groundwater. Alternatives 1 and 2 will not impact site contamination other than that created by natural attenuation mechanisms. Alternatives 2A, 3, 4, 4A, 5, and 6 will reduce the mobility, toxicity, and volume of contaminants. Alternate 3, with the groundwater recovery and expanded sparge/SVE systems, will have the greatest impact by reducing contaminant concentration at the western part of the facility and at the most severely impacted area. Operation of the groundwater recovery system will minimize off-site migration of contaminated groundwater from the facility and essentially eliminate discharge of contaminants to Hurricane Creek.

5. Cost
Alternative costs are presented for the initial capitol cost, 5 years of operation, and the sum of capitol and 5 year operational costs. Alternative 4A has the highest capital costs for the off-site soil disposal and highest total cost. Alternative 3, which includes the full scale sparge/SVE system, is about 80 percent higher than Alternative 2A which proposes operation of the existing recovery system, and about 15% higher than Alternative 5 which proposes the focused sparge/SVE system.

6. Overall Protection of Human Health and the Environment
Alternate 2 provides protection to human health and the environment through implementation of institutional controls and monitoring. Alternative 2A-6 offer additional protection to human health and the environment over the long term by reducing the mobility, toxicity, and volume of contaminants at the site. Alternative 3, which offers the greatest reduction in contaminants also provides the highest degree of protection of Human Health and the Environment.

7. Attain Media Cleanup Standards
Alternative 3 has the greatest potential to reduce groundwater concentration levels to below maximum concentration levels (MCL)s of the Safe Drinking Water Act, and also reduce soil concentrations to cleanup levels.

8. Control Sources of releases
The cleanup activities performed in 1985 eliminated the primary sources of releases to the environment. Any current waste generation and handling at the facility is subject to RCRA

regulations. Alternative 3 provides the greatest control of reducing remaining contamination resulting from past releases.

9. Comply with Standards for Management of Wastes
The activities discussed in all alternatives provide for adequate management of wastes handled or generated during implementation of the corrective measure. A Water Pollution Control Facility Construction Permit was granted by the State for installation of the groundwater recovery treatment system; the system discharges VOCs to the atmosphere at rates allowed by the State. Permission was granted by the City of Franklin to discharge the treated water to the municipal sanitary sewer system. Monthly monitoring of VOCs in the treated effluent was initially required which may eventually by modified to quarterly monitoring. Data indicates that the levels of toxic metals in the treated water discharged to the city sewer/water treatment system are below drinking water standards. Discharge of VOCs to the atmosphere by the sparge/SVE systems would be controlled as needed to meet State standards. Treatment of excavated soil by placing the soils containing volatile compounds in windrows may require a State permit. Off-site disposal of excavated soil must be performed in accordance with RCRA regulations.

PROPOSED REMEDY

Alternative 3 which includes institutional controls, monitoring, the expanded sparge/SVE system combined with an on-site groundwater recovery system, is deemed to best satisfy the nine criteria noted above and is the remedy proposed by U.S. EPA. The configuration of the sparging/SVE system and the existing groundwater recovery system is shown in Figure 5-4 (see Attachment A). The incorporation of the expanded sparge/SVE system is in keeping with Agency policy. Agency policy is that groundwater be restored to the extent practicable, and that soils that act as contaminant feed source to groundwater be treated so as to minimize this effect.

Operation of the groundwater recovery system will lower the water table at the storm sewer and when operated to maximum capacity will essentially eliminate discharge of contaminated water to Hurricane Creek. The groundwater recovery system will capture the major part of the contaminant plume of groundwater containing VOCs and any toxic metals exceeding limits, and act as a barrier to downgradient migration. Though site conditions may not be ideal for a sparge/SVE system, this technology is perceived as the way to augment the groundwater recovery system.
The expanded version of the sparge/SVE system will provide expansive remediation of soil and ground water at the site. Non-aqueous phase liquids, if extensive in subsurface, may

require long term operation of the groundwater and sparge/SVE systems. Through aeration and groundwater withdrawal which enhances volatilization and solution of these liquids, significant removal of non-aqueous phase liquids is expected.

The proposed remedy does not remediate contaminated groundwater that has migrated down gradient beyond the reach of the groundwater and sparge/SVE systems. Ideally, the sparge/SVE system and groundwater recovery wells would also be installed at off-site locations to provide more expansive remediation of the site. However these target locations are comprised of residential properties and construction of these systems would be highly invasive to these properties. In weighing the benefit of extending remedial action into residential areas against the invasive nature of such action, limiting construction to on-site locations is deemed the most advisable approach.

The on-site recovery system will undergo a detailed evaluation and will be upgraded as needed to maximize the effectiveness of the system. Monitoring of water quality at the storm sewer outfall will provide data to evaluate the effectiveness of the recovery system in preventing discharge of contaminated water to Hurricane Creek. Sampling/analysis of monitoring wells and soils will provide a broad assessment of the impact of the remedial measures on groundwater and soils.

Sparge/SVE systems in particular tend to achieve high contaminant reduction during the initial period of operation with significant decline in contaminant removal thereafter. Though cost estimates were based on a 5 year operational period, U.S. EPA does not intend that either the sparge/SVE or groundwater recovery systems continue to operate if no longer effective. It is anticipated that the systems will eventually change to alternate periods of operation and shutdown and ultimate shutdown of operations when monitoring data indicates that operations no longer result in appreciable impact to the environment.

Long term enactment of institutional controls are an important part of the remedy. A deed restriction limiting access to contaminants at the facility and restrictions for off-site water well drilling will prevent contact with contaminants.
Over the long term, natural attenuation is expected to reduce contaminant levels at off-site areas not addressed by pro-active remediation.

Operable Area 3 (Forsythe Street and Hamilton Avenue)
Institutional controls and monitoring are the alternative

corrective measures proposed for Operable Area 3. Proposed remedial activities for this area are limited to institutional controls and monitoring due to the serious restrictions that would be encountered in implementing an effective remedy at this location. The long and relatively narrow band of contamination in the thin water bearing zone likely could best be remediated by a lateral drainage system (horizontal collector wells) placed parallel to the roadway; or by a vacuum driven well point system of numerous closely spaced small diameter wells similar to that used in dewatering operations. Operation of these systems would likely achieve relatively rapid and uniform reduction of groundwater contaminants at this location. However, construction of lateral drainage systems, recovery wells and sparge/SVE systems would be highly invasive to the neighborhood. Further, operation of all of these technologies require pipeline construction which creates a high potential for damage to the utility supply lines leading to residential homes. Therefore, monitoring of groundwater coupled with institutional controls is deemed the most appropriate remedy for the Forsythe Street area.

The monitoring program for Operable Area 3 Forsythe Street includes the installation of an additional well screened in the deep aquifer (Unit D) at Forsythe Street. If monitoring data indicates significant contaminant concentration increase or migration, corrective measures to remove or contain the contamination will be given further consideration. Since the contaminant source input has been essentially eliminated at this area, contaminant concentrations are expected to decline over time.

## FUTURE CORRECTIVE ACTION

Pursuant to the Administrative Order on Consent under which the RFI and CMS were performed, a new Administrative Order on Consent will be developed following the final selection of the remedy by U.S. EPA. Under this new Order, corrective measure design details, monitoring program specifics, and cleanup standards will be established.

## PUBLIC PARTICIPATION

U.S. EPA solicits input from the community on the cleanup methods proposed for each of the corrective measure alternatives discussed and also invites the public to comment on alternatives not addressed in this Statement of Basis. The public comment period will be extended for fourty five days, and if requested

U.S. EPA will hold a public meeting in Franklin, Indiana to discuss the alternatives.

The Administrative Record for the FPP/Amphenol facility is available at the following locations:

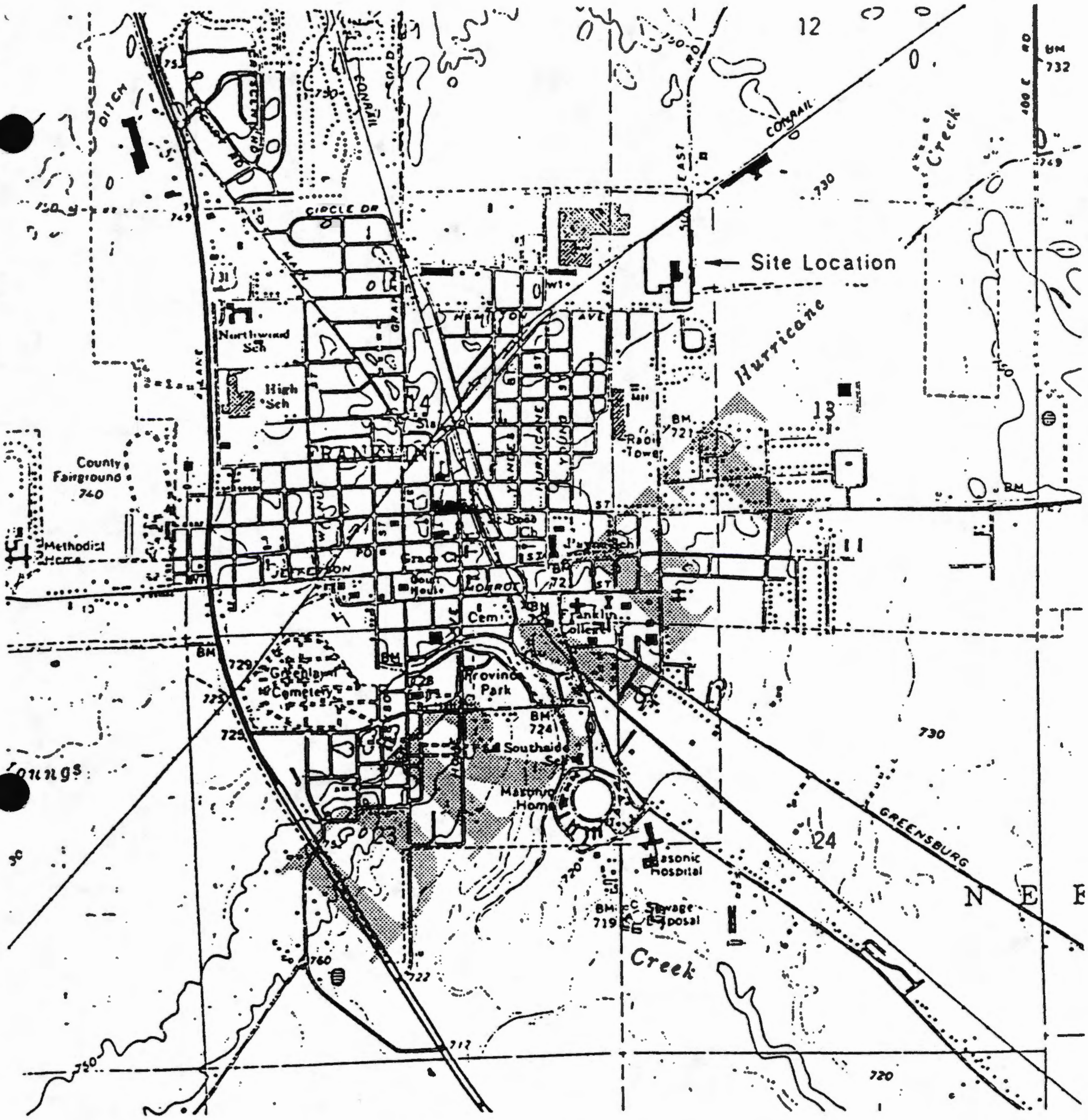
Johnson County Library
401 State Street
Franklin, Indiana 46131

U.S. EPA, Region 5
Waste, Pesticides and Toxics Division Record Center
77 West Jackson Boulevard, 7th Floor
Chicago, Illinois 60604
(312) 353-5821
Hours: Mon-Fri, 8 a.m. - 4p.m.

After consideration of the comments received, U.S. EPA will summarize the comments and its responses to the comments, select and document the remedial selection in a Response to Comments (RTC). The RTC will be incorporated into the Administrative Record. To send written comments or obtain further information, contact:

David Novak
Community Relations Coordinator
U.S. Environmental Protection Agency
77 West Jackson Boulevard, P-19J
Chicago, Illinois 60604
(312) 886-8963

ATTACHMENT A
FIGURES




Base taken from USGS Franklin, Ind. 7.5' topographic quadrangle


0 2000 feet

Scale

Figure 1

Former Franklin, IN Amphenol Facility
Site Location Map

WW Engineering & Science
5010 Stone Mill Road
Bloomington, Indiana 47408 • (812) 336-0972
A Summit Environmental Group Company

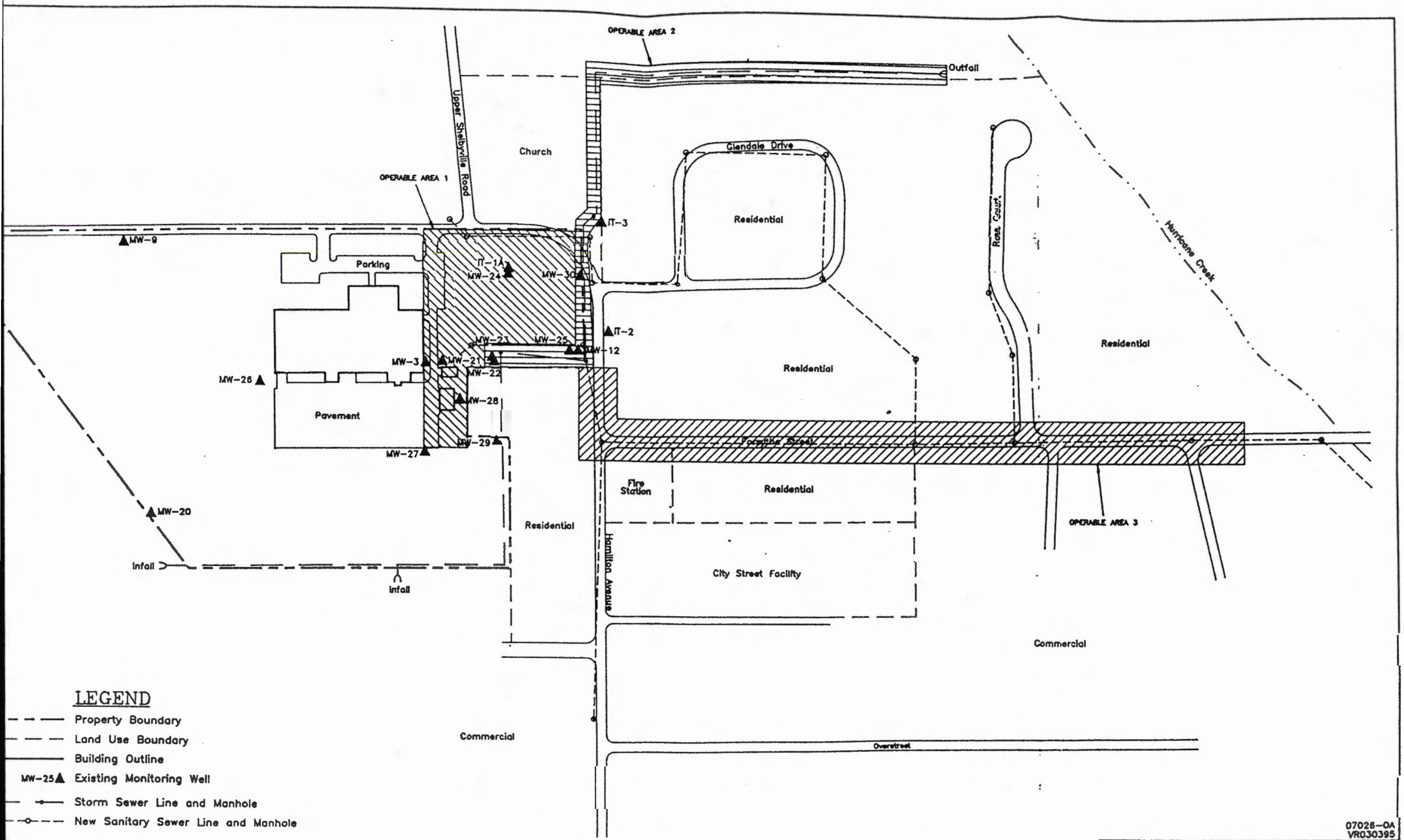



FIGURE 5-1

# OPERABLE AREAS 1,2 & 3

FORMER AMPHENOL SITE
FRANKLIN, INDIANA

MARCH, 1995

07026.08

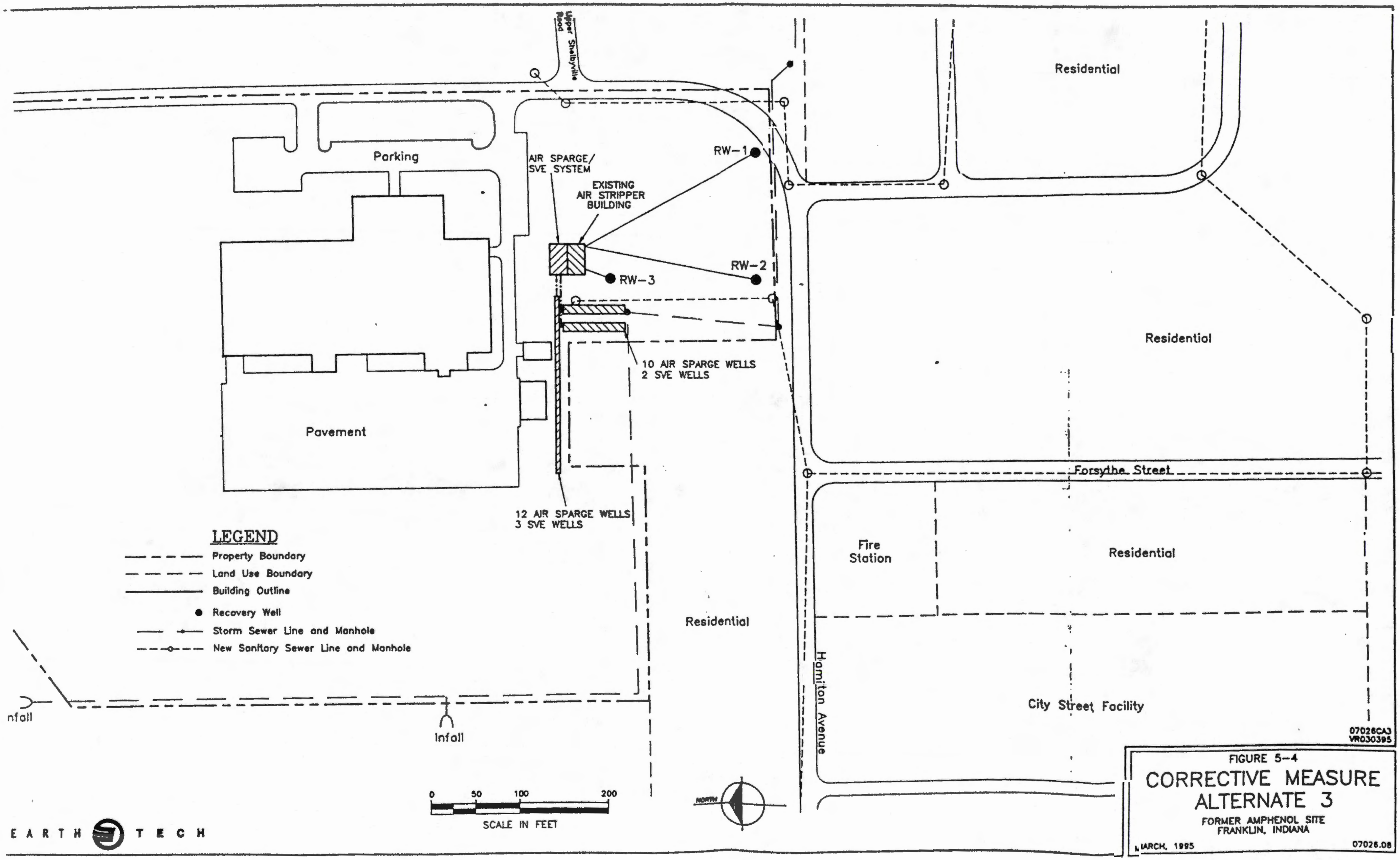



FIGURE 5-4
CORRECTIVE MEASURE ALTERNATE 3
FORMER AMPHENOL SITE
FRANKLIN, INDIANA
MARCH, 1995
07026.08

ATTACHMENT B
TABLES

**Table 4 Summary of Risk and Hazard Calculations for the Former Amphenol Site**

| RESIDENTIAL ADULT (LONG TERM) | | SITE-SPECIFIC 95% UCL | | BACKGROUND MAXIMUM | |
|---|---|---|---|---|---|
| Matrix | Route | Risk | Hazard | Risk | Hazard |
| SOIL | Ingestion | 9E-06 | 9E-02 | 1E-05 | 7E-02 |
| | Dermal | 2E-06 | 4E-02 | 2E-06 | 5E-02 |
| | Inhalation | 8E-07 | 1E-02 | 1E-06 | 1E-02 |
| Total | | 1E-05 | 1E-01 | 1E-05 | 1E-01 |
| **RESIDENTIAL CHILD (SHORT TERM)** | | **SITE-SPECIFIC 95% UCL** | | **BACKGROUND MAXIMUM** | |
| Matrix | Route | Risk | Hazard | Risk | Hazard |
| SOIL | Ingestion | 2E-05 | 6E-01 | 2E-05 | 4E-01 |
| | Dermal | 7E-07 | 5E-02 | 6E-07 | 7E-02 |
| | Inhalation | 8E-07 | 4E-02 | 9E-07 | 6E-02 |
| Total | | 2E-05 | 7E-01 | 2E-05 | 6E-01 |
| **RESIDENTIAL ADULT (LONG TERM)** | | **SITE-SPECIFIC MAXIMUM** | | **BACKGROUND MAXIMUM** | |
| Matrix | Route | Risk | Hazard | Risk | Hazard |
| SOIL | Ingestion | 1E-05 | 3E-01 | 1E-05 | 7E-02 |
| | Dermal | 3E-06 | 1E-01 | 2E-06 | 5E-02 |
| | Inhalation | 1E-06 | 2E-02 | 1E-06 | 1E-02 |
| Total | | 2E-05 | 4E-01 | 1E-05 | 1E-01 |
| **RESIDENTIAL CHILD (SHORT TERM)** | | **SITE-SPECIFIC MAXIMUM** | | **BACKGROUND MAXIMUM** | |
| Matrix | Route | Risk | Hazard | Risk | Hazard |
| SOIL | Ingestion | 3E-05 | 1E+00 | 2E-05 | 4E-01 |
| | Dermal | 1E-06 | 1E-01 | 6E-07 | 7E-02 |
| | Inhalation | 1E-06 | 9E-02 | 9E-07 | 6E-02 |
| Total | | 3E-05 | 1E+00 | 2E-05 | 6E-01 |
| **RESIDENTIAL ADULT (LONG TERM)** | | **SITE-SPECIFIC AVERAGE** | | **BACKGROUND AVERAGE** | |
| Matrix | Route | Risk | Hazard | Risk | Hazard |
| SOIL | Ingestion | 6E-07 | 2E-02 | 9E-07 | 2E-02 |
| | Dermal | 1E-07 | 1E-02 | 2E-07 | 2E-02 |
| | Inhalation | 6E-08 | 4E-03 | 1E-07 | 5E-03 |
| Total | | 8E-07 | 4E-02 | 1E-06 | 4E-02 |
| **RESIDENTIAL CHILD (SHORT TERM)** | | **SITE-SPECIFIC AVERAGE** | | **BACKGROUND AVERAGE** | |
| Matrix | Route | Risk | Hazard | Risk | Hazard |
| SOIL | Ingestion | 3E-06 | 1E-01 | 5E-06 | 1E-01 |
| | Dermal | 2E-07 | 1E-02 | 2E-07 | 3E-02 |
| | Inhalation | 2E-07 | 2E-02 | 3E-07 | 2E-07 |
| Total | | 4E-06 | 2E-01 | 6E-06 | 2E-01 |

Attachment 2

## High Capacity Well Information
## DNR Data Base

Search Criteria
Circle Center: 370000 North    580000 East
Radius: 10000 meters
Note:

DNR data base
WHP data?

Well Information Report

---

Registration # 41-00140-PS
Main Facility Location:
Township : 13N
Section : 21
Range : 4E
Well Number : 1
Owner Name : NEW WHITELAND, TOWN OF
UTMN : 378775
UTME : 578725
Distance from center: 8867 meters. ??
Capacity : 220 GPM
Depth : 146 feet.
Diameter : 12SG inches.

1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.59 | 4.14 | 4.00 | 4.10 | 4.68 | 5.01 | 4.77 | 5.47 | 5.00 | 2.80 | 4.52 | 3.86 |

---

Registration # 41-00219-IR
Main Facility Location:
Township : 12N
Section : 18
Range : 5E
Well Number : 1
Owner Name : HILLVIEW COUNTRY CLUB
UTMN : 371250
UTME : 584175
Distance from center: 4358 meters.
Capacity : 225 GPM
Depth : 124 feet.
Diameter : 8SG inches.

1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 2.80 | 4.88 | 4.02 | 5.05 | 5.28 | 0.00 | 0.00 | 0.00 |

---

Registration # 41-00559-PS
Main Facility Location:
Township : 12N
Section : 12
Range : 4E
Well Number : 2
Owner Name : INDIANA-AMERICAN WATER CO, INC
UTMN : 372325
UTME : 583475

Distance from center: 4181 meters.
Capacity : 300 GPM
Depth : 111 feet.
Diameter : 16SG inches.

# 2

1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

---

Registration # 41-00559-PS
Main Facility Location:
Township : 12N
Section : 12
Range : 4E
Well Number : 3
Owner Name : INDIANA-AMERICAN WATER CO, INC
UTMN : 372125
UTME : 583375
Distance from center: 3988 meters. ?
Capacity : 280 GPM
Depth : 107 feet.
Diameter : 16SG inches.

aquifer test ?

1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 ? |

---

Registration # 41-00559-PS
Main Facility Location:
Township : 12N
Section : 12
Range : 4E
Well Number : 4
Owner Name : INDIANA-AMERICAN WATER CO, INC
UTMN : 372210
UTME : 583575
Distance from center: 4203 meters.
Capacity : 300 GPM
Depth : 98 feet.
Diameter : 16SG inches.

1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

---

Registration # 41-00559-PS
Main Facility Location:
Township : 12N
Section : 12
Range : 4E
Well Number : 5
Owner Name : INDIANA-AMERICAN WATER CO, INC
UTMN : 372120
UTME : 583500
Distance from center: 4092 meters. ?

Capacity : 300 GPM
Depth : 87 feet.
Diameter : 16SG inches.

# 5

55 MG / 30 D = 1.5 MGD

1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 55.10 | 47.17 | 46.27 | 52.16 | 59.29 | 72.83 | 54.11 | 40.40 | 38.17 | 36.65 | 34.61 | 33.62 |

only 1 well pumped ??

---

Registration # 41-00560-PS
Main Facility Location:
Township : 12N
Section : 23
Range : 4E
Well Number : 1 CANA
Owner Name : INDIANA-AMERICAN WATER CO, INC
UTMN : 369330
UTME : 581045
Distance from center: 1241 meters.
Capacity : 40 GPM
Depth : 57 feet.
Diameter : 10SG inches.

1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

---

Registration # 41-00560-PS
Main Facility Location:
Township : 12N
Section : 23
Range : 4E
Well Number : 1 MASO
Owner Name : INDIANA-AMERICAN WATER CO, INC
UTMN : 368890
UTME : 581375
Distance from center: 1767 meters.
Capacity : 208 GPM
Depth : 49 feet.
Diameter : 12SG inches.

1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.99 | 4.36 | 4.47 | 4.85 | 5.16 | 7.40 | 5.11 | 5.98 | 3.99 | 3.30 | 2.96 | 2.89 |

---

Registration # 41-01370-IN
Main Facility Location:
Township : 13
Section : 22
Range : 4E
Well Number : 1
Owner Name : IRVING MATERIALS INC
UTMN : 379325
UTME : 578925
Distance from center: 9387 meters.
Capacity : 50 GPM

Depth : 26 feet.
Diameter : 6SD inches.
1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| .03 | .05 | .16 | .15 | .20 | .20 | .21 | .26 | .18 | .29 | .25 | .17 |

---

Registration # 41-01370-IN
Main Facility Location:
Township : 13
Section : 22
Range : 4E
Well Number : 2
Owner Name : IRVING MATERIALS INC
UTMN : 379350
UTME : 578900
Distance from center: 9414 meters.
Capacity : 50 GPM
Depth : 26 feet.
Diameter : 6SD inches.
1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

---

Registration # 41-01370-IN
Main Facility Location:
Township : 13
Section : 22
Range : 4E
Well Number : 3
Owner Name : IRVING MATERIALS INC
UTMN : 379330
UTME : 578850
Distance from center: 9401 meters.
Capacity : 70 GPM
Depth : 26 feet.
Diameter : 8SD inches.
1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

---

Registration # 41-01995-PS
Main Facility Location:
Township : 12N
Section : 24
Range : 4E
Well Number : 1
Owner Name : FRANKLIN WWTP, CITY OF
UTMN : 369050
UTME : 582150
Distance from center: 2351 meters.
Capacity : 100 GPM

Depth : 90 feet.
Diameter : 6SD inches.

Franklin Well

1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| .01 | .04 | .01 | .77 | .88 | .82 | .81 | .82 | .78 | .76 | .05 | .31 |

/30 .029 MGD

---

Registration # 41-02403-PS
Main Facility Location:
Township : 12N
Section : 23
Range : 4E
Well Number : 1
Owner Name : IN MASONIC HOME
UTMN : 369225
UTME : 582000
Distance from center: 2145 meters.
Capacity : 120 GPM
Depth : 200 feet.
Diameter : 10LS inches.
1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.17 | 2.72 | 3.03 | 3.25 | 3.70 | 4.03 | 4.13 | 3.53 | 3.25 | 3.17 | .75 | 3.01 |

---

Registration # 41-02403-PS
Main Facility Location:
Township : 12N
Section : 23
Range : 4E
Well Number : 2
Owner Name : IN MASONIC HOME
UTMN : 369250
UTME : 582075
Distance from center: 2206 meters.
Capacity : 100 GPM
Depth : 140 feet.
Diameter : 6SG inches.
1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

---

Registration # 41-02403-PS
Main Facility Location:
Township : 12N
Section : 23
Range : 4E
Well Number : 3
Owner Name : IN MASONIC HOME
UTMN : 369150
UTME : 582250
Distance from center: 2405 meters.
Capacity : 275 GPM

Depth : 90 feet.
Diameter : 12SG inches.
1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

---

Registration # 41-02498-PS
Main Facility Location:
Township : 13N
Section : 21
Range : 4E
Well Number : 3
Owner Name : WHITELAND WATER
UTMN : 378500
UTME : 578650
Distance from center: 8607 meters.
Capacity : 450 GPM
Depth : 165 feet.
Diameter : 12SG inches
1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | .76 | 1.49 | .28 | .69 | .32 | 0.00 | 0.00 | .99 |

---

Registration # 41-03182-IR
Main Facility Location:
Township : 13N
Section : 36
Range : 3E
Well Number : 7
Owner Name : BREHOB NURSERY INC
UTMN : 375325
UTME : 573860
Distance from center: 8127 meters.
Capacity : 80 GPM
Depth : 500 feet.
Diameter : 8SH inches.
1994 Water Use: Million Gallons

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 1.61 | 2.64 | 2.76 | 2.78 | 1.54 | 1.69 | 0.00 | .81 |

---

Registration # 41-03826-IR
Main Facility Location:
Township : 12N
Section : 1
Range : 4E
Well Number : 1
Owner Name : THE LEGENDS OF INDIANA G. C.
UTMN : 373350
UTME : 582875
Distance from center: 4415 meters.
Capacity : 700 GPM

Attachment 3

# Example GFLOW Input File

```
* Written by GFLOW1 version 1.1
error error.log
yes
message nul
echo con
quit
modelorigin   570000   4400000 1
title BASERUN
layout
window  38175.00    -95700.00    46550.00    -86950.00
quit
aquifer
permeability  20.00000
thickness    60.00000
base       575.0000
porosity    0.2500000
reference    1143557.    -45235.96      714.4284
uniflow     0.0000000     0.0000000
quit
inhomogeneity
*      hydraul. cond.   added exf.rate   porosity
inhom    20.00000     -0.4566000E-03   0.2500000
   75322.1563    -187309.5780  2inRAIN
  186464.2340      59111.9492  2inRAIN
    9839.1953    104610.4450  2inRAIN
 -127184.0230   -170055.4840  2inRAIN
*      hydraul. cond.   added exf.rate   porosity
inhom   300.0000     -0.1369860E-02   0.2500000
  -74349.6094   -139366.2190  9-6inASH
  -55169.1914   -124037.7810  9-6inASH
  -63321.2305   -111180.9690  9-6inASH
  -46532.9453   -101793.1170  9-6inASH
  -34543.3789    -95859.7656  9-6inASH
  -32144.0195    -85474.5859  9-6inASH
  -21592.6211    -79541.2344  9-6inASH
  -12479.3936    -64220.0234  9-6inASH
   -7930.8887    -59277.2227  9-6inASH
    -329.7206    -52011.1602  9-6inASH
    3462.6899    -39146.3867  9-6inASH
    3114.9365    -33267.9492  9OUTWASH
    3383.7715    -26061.9590  9OUTWASH
    2854.8621    -21201.0977  9OUTWASH
    1294.4794    -13156.1104  9OUTWASH
    4747.9634     -8059.6499  9OUTWASH
    7892.3843      2443.7151  9OUTWASH
   13045.8906     10213.2881  9OUTWASH
   16184.5186     18812.9707  9OUTWASH
```

| | | |
|---|---|---|
| 18283.4395 | 24900.2109 | 9OUTWASH |
| 20460.6699 | 29233.8906 | 9OUTWASH |
| 23455.8125 | 33883.6563 | 9OUTWASH |
| 31217.4219 | 38933.9922 | 9OUTWASH |
| 39813.3789 | 33827.3711 | 9OUTWASH |
| 44075.9297 | 37305.9141 | 9OUTWASH |
| 39163.6133 | 42701.2188 | 9OUTWASH |
| 44843.6367 | 45272.0781 | 9OUTWASH |
| 50467.3359 | 48703.0234 | 9OUTWASH |
| 64497.6328 | 42978.6055 | 9OUTWASH |
| 71775.8047 | 61283.7500 | 9OUTWASH |
| 62365.0195 | 67141.0781 | 9OUTWASH |
| 54198.4805 | 62380.8281 | 9OUTWASH |
| 42122.5938 | 53962.7656 | 9OUTWASH |
| 34488.5391 | 51217.3945 | 9OUTWASH |
| 29982.4258 | 46262.3438 | 9OUTWASH |
| 26485.3555 | 44859.4141 | 9OUTWASH |
| 22792.0488 | 46663.5977 | 9OUTWASH |
| 23724.6270 | 51874.7344 | 9OUTWASH |
| 27911.6387 | 59925.0664 | 9OUTWASH |
| 36558.9141 | 73444.5781 | 9OUTWASH |
| 46732.5586 | 86544.8203 | 9OUTWASH |
| 36404.8672 | 91158.7344 | 9OUTWASH |
| 27912.0176 | 82050.2344 | 9OUTWASH |
| 18984.0430 | 65153.1406 | 9OUTWASH |
| 10131.7158 | 48722.4570 | 9OUTWASH |
| 6523.1143 | 40754.5391 | 9OUTWASH |
| 6466.5269 | 34842.6758 | 9OUTWASH |
| 5883.6816 | 28630.5430 | 9OUTWASH |
| -16131.4365 | 19851.5762 | 9OUTWASH |
| -22141.5156 | 11029.8467 | 9OUTWASH |
| -14436.8340 | 1662.8923 | 9OUTWASH |
| -11974.0576 | -11759.8672 | 9OUTWASH |
| -13239.2734 | -16728.9941 | 9OUTWASH |
| -16285.7295 | -26139.7539 | 9OUTWASH |
| -17755.0918 | -36533.4453 | 9OUTWASH |
| -22076.8301 | -49881.6875 | 9OUTWASH |
| -34066.3984 | -70644.8125 | 9OUTWASH |
| -41257.2461 | -80039.8906 | 9OUTWASH |
| -54208.0039 | -79049.7969 | 9OUTWASH |
| -66674.5547 | -87946.2188 | 9OUTWASH |
| -80102.2891 | -104264.7500 | 9OUTWASH |
| -89692.5000 | -127990.9380 | 9OUTWASH |

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*     hydraul. cond.   added exf.rate   porosity
inhom    5.000000     0.3424700E-03   0.2500000
 -62137.5938  -162897.7500  .BED.5in
 -47913.0508  -168163.2500  .BED.5in
```

```
-21823.1211   -167329.7810  .BED.5in
 18603.8008   -165133.7190  .BEDROCK
 38896.2422   -155005.0000  .BEDROCK
 45096.1211   -143721.0000  .BEDROCK
 21818.5449   -123699.9300  .BEDROCK
 20170.4004   -109715.4770  .BEDROCK
 13596.4053   -109715.4770  .BEDROCK
  4959.1299   -106326.2420  .BEDROCK
 -3678.1450   -108866.6170  .BEDROCK
 -4496.0220   -102930.8200  .BEDROCK
  9891.1748    -99541.5859  .BEDROCK
 16471.3652    -91486.7344  .BEDROCK
  9482.2363    -84280.7500  .BEDROCK
  -388.0496    -85978.4609  .BEDROCK
  1260.0962    -74113.0547  .BEDROCK
-11485.1514    -72836.6641  .BEDROCK
-39888.3867   -104619.9920  .BEDROCK
-45725.5039   -115145.4920  .BEDROCK
-52288.1406   -135449.0000  .BEDROCK
-58488.0195   -151993.0000  .BEDROCK
*     hydraul. cond.  added exf.rate  porosity
inhom   150.0000    -0.1826500E-02  0.2500000
 44131.1094   -131142.7190  15-8in-T
 49452.9688   -141009.0000  11-8in-T
 64873.5469   -149232.2500  11-8in-T
 76575.2344   -129499.6800  11EF_OUT
 89342.8984   -115241.2500  11EF_OUT
110614.3130    -87277.4297  11EF_OUT
103705.5160    -57125.5508  11EF_OUT
 94127.7656    -54384.4727  11EF_OUT
 81897.0938    -49447.3242  11EF_OUT
 85087.0078    -30804.7734  11EF_OUT
 76575.2344    -19840.4531  11EF_OUT
 67005.5000    -14911.3193  11EF_OUT
 56361.7734    -23679.5684  11EF_OUT
 60617.6602    -36294.9492  11EF_OUT
 65939.5234    -48902.3125  11EF_OUT
 63703.5664    -70679.3672  11EF_OUT
 62280.7695    -82777.1406  11EF_OUT
 59614.7031    -89191.7813  11EF_OUT
 64236.7773    -96705.0000  11EF_OUT
 61570.7109   -100555.3910  11EF_OUT
 56412.7422   -105322.1560  11EF_OUT
 53746.6758   -108438.3670  11EF_OUT
 52147.0352   -112468.2810  11EF_OUT
 46989.0664   -112653.1640  11EF_OUT
 45566.2734   -108620.5780  11EF_OUT
```

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   45745.7969   -104038.6880  11EF_OUT
   41146.6836   -100784.2030  11EF_OUT
   40145.8281    -97369.4453  11EF_OUT
   42534.1836    -94906.7813  11EF_OUT
   43920.5234    -93636.5469  11EF_OUT
   45147.6719    -92538.4141  11EF_OUT
   46622.8984    -91387.3828  11EF_OUT
   47175.6992    -90282.1094  11EF_OUT
   47393.1367    -89011.3516  11EF_OUT
   46958.2578    -87590.8906  11EF_OUT
   46087.4102    -86096.1406  11EF_OUT
   45217.6523    -84227.6953  11EF_OUT
   44347.8984    -81910.1641  11EF_OUT
   44347.8984    -80415.4063  11EF_OUT
   45217.6523    -78621.2656  11EF_OUT
   45580.4180    -76453.4297  11EF_OUT
   43695.5820    -75706.0547  11EF_OUT
   42680.5039    -78023.5781  11EF_OUT
   42535.1797    -80565.1016  11EF_OUT
   42607.2930    -82881.5391  11EF_OUT
   42919.6641    -86328.6641  11EF_OUT
   42389.8555    -88637.6641  11EF_OUT
   41664.3320    -90430.7109  11EF_OUT
   40577.1367    -91851.1641  11EF_OUT
   39143.8086    -93794.4531  11EF_OUT
   37294.1953    -95938.9844  11EF_OUT
   36369.9688    -98957.8125  11EF_OUT
   36755.4492   -102372.5700  11EF_OUT
   41300.5664   -105137.2730  11EF_OUT
   41833.7813   -109904.0390  11EF_OUT
   43433.4180   -117602.1410  11EF_OUT
quit
well
discharge
*    x          y        discharge    radius     label
-2789.000   -31645.00    133700.0    2.000    SWF-146943501
-3122.000   -32905.00    133700.0    2.000    SWF-246943501
-6898.000   -28897.00    133700.0    2.000    SWF-346943501
-8565.000   -30500.00    133700.0    2.000    SWF-446943501
 28625.00   -69635.00    19390.00    1.500    __NONE___4601
 46506.00   -94324.00    8069.000    1.500    __NONE___4602
 44209.00   -90797.00    83556.00    1.500    WEBB-1
 43881.00   -91453.00    83556.00    1.500    WEBB-2
 44537.00   -91174.00    83556.00    1.500    WEBB-3
 44291.00   -91469.00    83556.00    1.500    WEBB-4
 29281.00   -67831.00    787.0000    1.500    __NONE___4607
 39862.00   -101542.0    2219.000    1.500    __NONE___4608
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 39370.00   -100967.0    13823.00    1.500   _NONE___4609
 28379.00   -70538.00    1659.000    1.500   _NONE___4610
 12664.00   -80955.00    5065.000    1.500   _NONE___4611
 42240.00   -87434.00    10402.00    1.500   _NONE___4612
 61105.00   -87434.00    57072.00    1.500   _NONE___4613
quit
linesink
stream 2160000.
end
* x     y   head    width    label
resistance 5.000000
depth 1.000000
 91712.  12163.  811.1000   50.00000  UP-SUG___0201
 86969.   2675.  800.3000   50.00000  UP-SUG___0202
 85071.  -7761.  786.9000   50.00000  UP-SUG___0203
 79853. -22941.  771.1000   50.00000  UP-SUG___0204
 75110. -33377.  755.2000   50.00000  UP-SUG___0205
 70840. -47133.  737.2000   50.00000  UP-SUG___0206
 73054. -63104.  723.7000   50.00000  UP-SUG___0207
 68627. -70377.  717.8000   50.00000  UP-SUG___0208
 64516. -74805.  713.0000   50.00000  UP-SUG___0209
 63567. -82079.  708.4000   50.00000  UP-SUG___0210
 61353. -87139.  701.8000   50.00000  UP-SUG___0211
 66729. -92515.  691.9000   50.00000  UP-SUG___0212
 65781. -100105. 685.2000   50.00000  UP-SUG___0213
 61669. -107379. 679.6000   50.00000  UP-SUG___0214
 58507. -113387. 674.4000   50.00000  UP-SUG___0215
 58823. -120029. 667.7000   50.00000  UP-SUG___0216
 50917. -127935. 660.4000   50.00000  UP-SUG___0217
 54079. -134892. 654.6000   50.00000  UP-SUG___0218
 54079. -143747.
stream
* x     y   head    width    label
depth 10.00000
 56609. -41282.  780.8000   20.00000  LSUG_____0101
 61669. -45710.  768.4000   20.00000  LSUG_____0102
 62618. -52984.  754.7000   20.00000  LSUG_____0103
 58507. -59941.  741.2000   20.00000  LSUG_____0104
 58507. -66899.  729.5000   20.00000  LSUG_____0105
 58507. -76702.  717.0000   20.00000  LSUG_____0106
 58191. -82079.  711.7000   20.00000  LSUG_____0107
 61037. -84609.
stream
* x     y   head    width    label
resistance 50.00000
 53693. -94237.  716.4000   20.00000  ADG______0101
 54396. -96205.  712.3000   20.00000  ADG______0102
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  53693.  -98313.  708.4000    20.00000   ADG______0103
  54677. -100702.  703.7000    20.00000   ADG______0104
  53834. -103373.  697.7000    20.00000   ADG______0105
  55099. -107027.  690.5000    20.00000   ADG______0106
  55239. -110401.  684.9000    20.00000   ADG______0107
  53834. -112931.  679.7000    20.00000   ADG______0108
  52147. -116023.
stream
*  x       y     head     width     label
resistance  20.00000
  50320. -117991.  674.4000    25.00000   YCG______0201
  50601. -122629.  669.4000    25.00000   YCG______0202
  50320. -127127.
stream
*  x       y     head     width     label
resistance  50.00000
  60405.   -5387.  787.7000    20.00000   BC______A0101
  63251.  -12503.  777.7000    20.00000   BC______A0102
  61828.  -18670.  770.7000    20.00000   BC______A0103
  62302.  -25311.  763.4000    20.00000   BC______A0104
  64200.  -34799.  756.3000    20.00000   BC______A0105
  67520.  -41440.
stream
end
*  x       y     head     width     label
resistance  25.00000
   7379. -109277.  756.2000    20.00000   STOTTG___0101
   4638. -112439.  743.5000    20.00000   STOTTG___0102
  -4428. -112228.  721.7000    20.00000   STOTTG___0103
  -6747. -114126.  713.1000    20.00000   STOTTG___0104
  -9277. -117710.  701.9000    20.00000   STOTTG___0105
 -15180. -119608.  689.0000    20.00000   STOTTG___0106
 -20030. -118132.  675.4000    20.00000   STOTTG___0107
 -23614. -115180.  662.9000    20.00000   STOTTG___0108
 -25933. -111174.  652.5000    20.00000   STOTTG___0109
 -31836. -110120.  642.0000    20.00000   STOTTG___0110
 -35421. -107168.  633.5000    20.00000   STOTTG___0111
 -37529. -102951.  623.7000    20.00000   STOTTG___0112
 -39848.  -98102.  612.7000    20.00000   STOTTG___0113
 -41535.  -90723.
stream
*  x       y     head     width     label
  -9066.  -96626.  711.8000    20.00000   NPRONG___0101
 -13494.  -99578.  691.2000    20.00000   NPRONG___0102
 -21084. -100632.  664.4000    20.00000   NPRONG___0103
 -28885. -101686.  642.0000    20.00000   NPRONG___0104
 -35842. -102951.
```

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stream
* x        y      head       width      label
resistance  100.0000
 23613.  -39349.  781.7000    10.00000   PLRUNC___0101
 20099.  -40474.  766.7000    10.00000   PLRUNC___0102
 18975.  -44972.  754.3000    10.00000   PLRUNC___0103
 17991.  -48345.  745.8000    10.00000   PLRUNC___0104
 15180.  -48907.  737.0000    10.00000   PLRUNC___0105
 13915.  -44269.  727.9000    10.00000   PLRUNC___0106
  9417.  -43285.  716.4000    10.00000   PLRUNC___0107
  6606.  -45393.  702.9000    10.00000   PLRUNC___0108
  3654.  -46237.  690.2000    10.00000   PLRUNC___0109
  1124.  -43144.  676.3000    10.00000   PLRUNC___0110
 -2952.  -41317.  664.0000    10.00000   PLRUNC___0111
 -6748.  -41176.  648.3000    10.00000   PLRUNC___0112
-11105.  -45674.
stream
* x        y      head       width      label
  2811.  -66337.  710.9000    10.00000   HONEY____0101
  -563.  -63947.  691.0000    10.00000   HONEY____0102
 -2250.  -59871.  672.2000    10.00000   HONEY____0103
 -4077.  -55514.  658.7000    10.00000   HONEY____0104
 -7450.  -52421.  649.0000    10.00000   HONEY____0105
 -9559.  -49610.  642.5000    10.00000   HONEY____0106
-12792.  -49751.
stream
* x        y      head       width      label
 22489. -119609.  748.4000    10.00000   BC______C0101
 27127. -115954.  720.0000    10.00000   BC______C0102
 34858. -118203.  704.7000    10.00000   BC______C0103
 39216. -119328.  695.1000    10.00000   BC______C0104
 42589. -115954.
stream
* x        y      head       width      label
 41465. -126075.  693.3000    5.000000   SCT1_____0101
 44416. -129026.  679.4000    5.000000   SCT1_____0102
 47368. -131135.  668.5000    5.000000   SCT1_____0103
 49898. -131557.
stream
* x        y      head       width      label
resistance  25.00000
 45762.  -90877.  723.5000    25.00000   HURRIC___0301
 45113.  -91079.  723.1000    25.00000   HURRIC___0302
 44607.  -91039.  722.3000    25.00000   HURRIC___0303
 44202.  -91140.  721.6000    25.00000   HURRIC___0304
 44040.  -91484.  721.4000    25.00000   HURRIC___0305
 43878.  -91971.  721.2000    25.00000   HURRIC___0306
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  43777.  -92457.  720.4000   25.00000   HURRIC___0307
  43635.  -92943.  719.7000   25.00000   HURRIC___0308
  43432.  -93429.  718.6000   25.00000   HURRIC___0309
  42946.  -93611.  717.9000   25.00000   HURRIC___0310
  42460.  -93895.  717.9000   25.00000   HURRIC___0311
  42075.  -94239.  717.3000   25.00000   HURRIC___0312
  41427.  -94806.  715.7000   25.00000   HURRIC___0313
  40698.  -95353.  714.5000   25.00000   HURRIC___0314
  40111.  -95799.  713.4000   25.00000   HURRIC___0315
  39442.  -96710.  710.7000   25.00000   HURRIC___0316
  38529.  -98780.
stream
*  x        y     head      width       label
  44567.  -76223.  738.2000   25.00000   HURRIC___0401
  43837.  -78274.  736.3000   25.00000   HURRIC___0402
  43518.  -80233.  735.7000   25.00000   HURRIC___0403
  43291.  -81920.  734.3000   25.00000   HURRIC___0404
  43245.  -83378.  732.9000   25.00000   HURRIC___0405
  43792.  -84380.  732.1000   25.00000   HURRIC___0406
  44293.  -85292.  730.6000   25.00000   HURRIC___0407
  44794.  -86522.  729.1000   25.00000   HURRIC___0408
  45432.  -87616.  727.9000   25.00000   HURRIC___0409
  45797.  -88846.  726.2000   25.00000   HURRIC___0410
  46070.  -89940.  724.5000   25.00000   HURRIC___0411
  45843.  -90715.
stream
*  x        y     head      width       label
  46936.  -68567.  750.8000   25.00000   HURRIC___0501
  46936.  -70709.  747.7000   25.00000   HURRIC___0502
  46936.  -72623.  744.3000   25.00000   HURRIC___0503
  46025.  -74218.  740.8000   25.00000   HURRIC___0504
  44931.  -75767.
stream
*  x        y     head      width       label
  20847.  -62529.  781.0000   25.00000   YCG______0301
  20744.  -65195.  777.4000   25.00000   YCG______0302
  20949.  -67758.  773.5000   25.00000   YCG______0303
  20949.  -71450.  769.1000   25.00000   YCG______0304
  20847.  -75141.  766.9000   25.00000   YCG______0305
  20334.  -77294.  764.4000   25.00000   YCG______0306
  20539.  -80780.  761.4000   25.00000   YCG______0307
  21770.  -82831.
stream
*  x        y     head      width       label
  20601.  -81131.  760.4000   25.00000   YCG______0301
  21832.  -84002.  755.2000   25.00000   YCG______0302
  20601.  -88103.  752.7000   25.00000   YCG______0303
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  20806.  -91897.  746.8000    25.00000  YCG______0304
  23267.  -93127.  742.4000    25.00000  YCG______0305
  24497.  -89334.  738.3000    25.00000  YCG______0306
  26753.  -88001.  735.6000    25.00000  YCG______0307
  28291.  -90666.  732.1000    25.00000  YCG______0308
  26958.  -93948.  729.4000    25.00000  YCG______0309
  28291.  -95691.  727.4000    25.00000  YCG______0310
  25318.  -97639.  724.2000    25.00000  YCG______0311
  26138. -100715.  721.7000    25.00000  YCG______0312
  28291.  -99792.  719.7000    25.00000  YCG______0313
  30444. -100100.  717.2000    25.00000  YCG______0314
  32803.  -99382.  714.7000    25.00000  YCG______0315
  34546.  -98254.  712.6000    25.00000  YCG______0316
  36596.  -98254.  710.3000    25.00000  YCG______0317
  38529.  -98780.
stream
*   x       y     head      width     label
  38529.  -98780.  708.2000    25.00000  YCG______0401
  38750. -100920.  706.2000    25.00000  YCG______0402
  37622. -102253.  704.5000    25.00000  YCG______0403
  38647. -102765.  702.2000    25.00000  YCG______0404
  40800. -102253.  700.0000    25.00000  YCG______0405
  42133. -103278.  698.4000    25.00000  YCG______0406
  42749. -105431.  696.1000    25.00000  YCG______0407
  43159. -107585.  693.4000    25.00000  YCG______0408
  43876. -110148.  690.5000    25.00000  YCG______0409
  43466. -113532.  687.8000    25.00000  YCG______0410
  44081. -114967.  685.7000    25.00000  YCG______0411
  46850. -114557.  682.5000    25.00000  YCG______0412
  49618. -114454.  679.8000    25.00000  YCG______0413
  50131. -117838.
head
* x1      y1      x2      y2     head     width     label
resistance 0.0000000
depth 0.0000000
 173778.    3150.  156701.  -14402.  854.9000   0.000 BBRG_____0101
 156701.  -14402.  138201.  -14402.  834.8000   0.000 BBRG_____0102
 138201.  -14402.  130611.  -39069.  810.7000   0.000 BBRG_____0103
 130611.  -39069.  116854.  -64211.  778.1000   0.000 BBRG_____0104
 116854.  -64211.  112110.  -81288.  749.0000   0.000 BBRG_____0105
 112110.  -81288.   92661.  -86032.  727.7000   0.000 BBRG_____0106
  92661.  -86032.   82699. -113071.  702.3000   0.000 BBRG_____0107
  82699. -113071.   56609. -142956.  668.9000   0.000 BBRG_____0108
  55186. -145328.   62776. -173790.  640.7000   0.000 DR_______0101
 -67201.   -4915.  -63406.  -18197.  727.3000   0.000 WLC______0101
 -63406.  -18197.  -58188.  -33377.  696.4000   0.000 WLC______0102
 -58188.  -33377.  -56291.  -51403.  668.7000   0.000 WLC______0103
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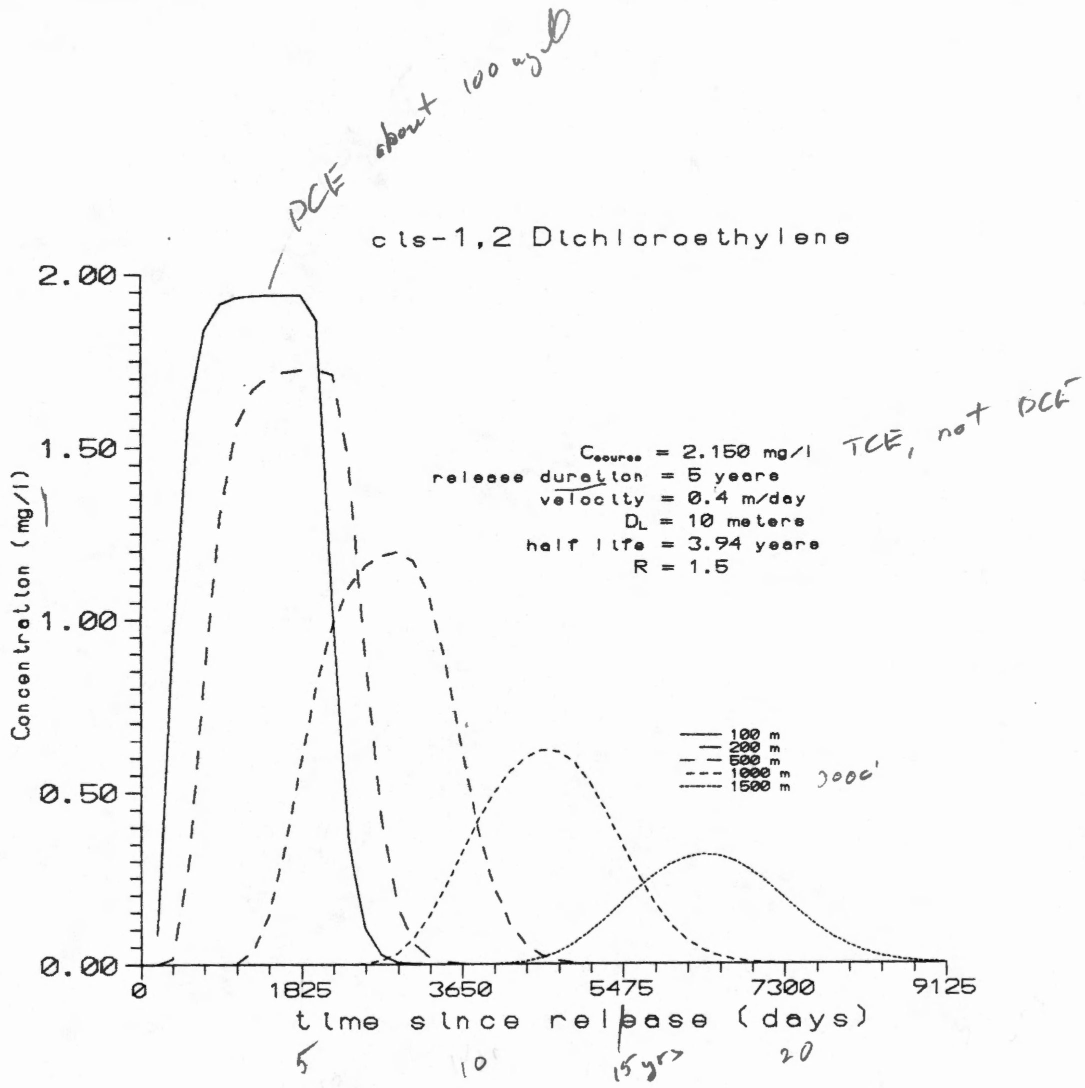
 -56291.  -51403.  -49649.  -65159.  645.5000     0.000 WLC______0104
 -49649.  -65159.  -50598.  -78916.  623.9000     0.000 WLC______0105
 -50598.  -78916.  -55816.  -91250.  604.7000     0.000 WLC______0106
 -31623.   22599.  -22610.   13586.  722.0000     0.000 EC_______0101
 -22610.   13586.  -10751.    5522.  698.5000     0.000 EC_______0102
 -10751.    5522.   -5533.   -2543.  682.2000     0.000 EC_______0103
  -5533.   -2543.   -4110.  -11081.  669.8000     0.000 EC_______0104
  42378.   83318.   29096.   61971.  724.8000     0.000 UWR______0101
  29096.   61971.   14390.   48215.  714.5000     0.000 UWR______0102
  14390.   48215.   -2687.   14060.  696.3000     0.000 UWR______0103
  53763.   59125.   72263.   65766.  785.0000     0.000 GR_______0101
  55186.   56279.   48071.   46792.  750.9000     0.000 UFC______0101
  48071.   46792.   40006.   43471.  740.6000     0.000 UFC______0102
  40006.   43471.   29570.   39676.  732.5000     0.000 UFC______0103
 139624.   64818.  124444.   59125.  899.0000     0.000 UP-SUG___0101
 124444.   59125.  109264.   57228.  877.6000     0.000 UP-SUG___0102
 109264.   57228.  103572.   42997.  861.3000     0.000 UP-SUG___0103
 103572.   42997.   97879.   25445.  841.9000     0.000 UP-SUG___0104
  97879.   25445.   91712.   12637.  823.4000     0.000 UP-SUG___0105
 134406.   41574.  123495.   37779.  900.4000     0.000 UP_BRAN__0101
 123495.   37779.  118752.   28291.  881.6000     0.000 UP_BRAN__0102
 118752.   28291.  119226.   16432.  868.4000     0.000 UP_BRAN__0103
 119226.   16432.  119226.    6945.  857.6000     0.000 UP_BRAN__0104
 -37790.  -83660.  -51547.  -93147.  606.8000     0.000 WREI1____0101
 -51547.  -93147.  -66727.  -91724.  595.3000     0.000 WREI1____0102
 -66727.  -91724.  -83330. -129674.  585.6000     0.000 WREI1____0103
resistance  20.00000
depth  10.00000
   4428.   -2067.     633.   -8708.  664.0000   200.000 WREI1____0201
    633.   -8708.   -7432.  -15824.  660.5000   200.000 WREI1____0202
  -7432.  -15824.  -11227.  -21991.  657.2000   200.000 WREI1____0203
 -11227.  -21991.  -12650.  -29106.  653.5000   200.000 WREI1____0204
 -12650.  -29106.  -14547.  -38120.  648.6000   200.000 WREI1____0205
 -14547.  -38120.  -13599.  -49030.  643.2000   200.000 WREI1____0206
 -13599.  -49030.  -17394.  -53300.  637.8000   200.000 WREI1____0207
 -17394.  -53300.  -20240.  -60415.  632.4000   200.000 WREI1____0208
 -20240.  -60415.  -21189.  -68480.  627.5000   200.000 WREI1____0209
 -21189.  -68480.  -27355.  -69429.  624.0000   200.000 WREI1____0210
 -27355.  -69429.  -32099.  -76544.  620.2000   200.000 WREI1____0211
 -32099.  -76544.  -35894.  -82237.  616.2000   200.000 WREI1____0212
  26249.   37781.   15813.   30191.  702.9000    50.000 LFC______0101
  15813.   30191.   11069.   21652.  699.2000    50.000 LFC______0102
  11069.   21652.    4902.   15485.  696.4000    50.000 LFC______0103
   4902.   15485.   -1739.   11216.  687.1000    50.000 LFC______0104
   2530.     305.   -2688.   11690.  676.7000    50.000 MWR______0101
resistance  50.00000
  99304.  -28158.   97406.  -35273.  795.1000    20.000 SNAIL____0101
```

```
 97406.  -35273.   94085.  -41915.  780.2000   20.000 SNAIL____0102
 94085.  -41915.   92662.  -47607.  770.7000   20.000 SNAIL____0103
 92662.  -47607.   87918.  -52825.  761.7000   20.000 SNAIL____0104
 87918.  -52825.   85547.  -59467.  751.4000   20.000 SNAIL____0105
 85547.  -59467.   79854.  -63262.  741.3000   20.000 SNAIL____0106
 79854.  -63262.   73213.  -63262.  733.2000   20.000 SNAIL____0107
resistance  20.00000
 120651.   5049.  118279.   -4913.  842.9000   50.000 UP_BRAN__0201
 118279.  -4913.  116856.  -18196.  827.6000   50.000 UP_BRAN__0202
 116856. -18196.  114484.  -30529.  811.5000   50.000 UP_BRAN__0203
 114484. -30529.  116856.  -41440.  795.0000   50.000 UP_BRAN__0204
 116856. -41440.  108791.  -47607.  780.9000   50.000 UP_BRAN__0205
 108791. -47607.   99778.  -55197.  767.0000   50.000 UP_BRAN__0206
  99778. -55197.   95034.  -66108.  752.8000   50.000 UP_BRAN__0207
  95034. -66108.   92662.  -79865.  735.8000   50.000 UP_BRAN__0208
resistance  25.00000
   8433. -135631.    2108. -140480.  769.2000   20.000 IC______B0101
   2108. -140480.   -8855. -137740.  713.0000   20.000 IC______B0102
  -8855. -137740.  -15813. -139215.  671.9000   20.000 IC______B0103
 -15813. -139215.  -24457. -141113.  652.0000   20.000 IC______B0104
 -24457. -141113.  -34999. -141956.  639.4000   20.000 IC______B0105
 -34999. -141956.  -45752. -142167.  627.9000   20.000 IC______B0106
 -45752. -142167.  -55029. -142378.  617.0000   20.000 IC______B0107
 -55029. -142378.  -64305. -130571.  602.6000   20.000 IC______B0108
 -64305. -130571.  -80118. -129939.  588.0000   20.000 IC______B0109
  30360. -138161.   36475. -143432.  715.9000   20.000 NC_______0101
  36475. -143432.   42167. -149336.  687.8000   20.000 NC_______0102
  42167. -149336.   47227. -156293.  664.2000   20.000 NC_______0103
  47227. -156293.   55661. -154185.  647.5000   20.000 NC_______0104
resistance  100.0000
  23895.  -29088.   17569.  -30072.  755.0000   10.000 LBC______0101
  17569.  -30072.   13634.  -30775.  738.0000   10.000 LBC______0102
  13634.  -30775.    9839.  -27823.  724.4000   10.000 LBC______0103
   9839.  -27823.   10822.  -23887.  715.5000   10.000 LBC______0104
  10822.  -23887.    6043.  -25855.  703.6000   10.000 LBC______0105
   6043.  -25855.    3513.  -27823.  693.2000   10.000 LBC______0106
   3513.  -27823.     280.  -30072.  681.7000   10.000 LBC______0107
    280.  -30072.   -6045.  -29088.  669.6000   10.000 LBC______0108
  -6045.  -29088.  -10824.  -29088.  657.5000   10.000 LBC______0109
 -36704.   -2312.  -39076.  -12274.  733.4000   20.000 EFWLC____0101
 -39076.  -12274.  -40500.  -20338.  717.8000   20.000 EFWLC____0102
 -40500.  -20338.  -42872.  -28877.  703.9000   20.000 EFWLC____0103
 -42872.  -28877.  -44295.  -37891.  688.8000   20.000 EFWLC____0104
 -44295.  -37891.  -48564.  -45955.  673.7000   20.000 EFWLC____0105
 -48564.  -45955.  -51411.  -52123.  659.0000   20.000 EFWLC____0106
resistance  0.0000000
depth  0.0000000
```

```
-87939.  -11799.  -78925.  -17492.  757.5000     0.000 WFWLC____0101
-78925.  -17492.  -71335.  -30301.  723.3000     0.000 WFWLC____0102
-71335.  -30301.  -64219.  -37416.  693.2000     0.000 WFWLC____0103
resistance  50.00000
depth  10.00000
 34929.     60.   31133.   -4683.  800.8000    20.000 LC_______0101
 31133.  -4683.   24966.  -10851.  782.0000    20.000 LC_______0102
 24966. -10851.   21646.  -16543.  756.0000    20.000 LC_______0103
 21646. -16543.    9786.  -15594.  720.0000    20.000 LC_______0104
  9786. -15594.    -176.  -14171.  685.2000    20.000 LC_______0105
quit
map
plot ALLMAP.MAP     SO-INDY.MAP
quit
switch
error con
message con
echo off
input con
```

Attachment 4

# SOLUTE Transport Modeling Results


PCE about 100 ug/l
cis-1,2 Dichloroethylene
2.00
1.50
1.00
0.50
0.00
Concentration (mg/l)
$C_{source}$ = 2.150 mg/l
TCE, not PCE
release duration = 5 years
velocity = 0.4 m/day
$D_L$ = 10 meters
half life = 3.94 years
R = 1.5
100 m
200 m
500 m
1000 m
1500 m
2000'
0
1825
3650
5475
7300
9125
time since release (days)
5
10
15 yrs
20

```
**************************************************************
*
*    INTERNATIONAL GROUND WATER MODELING CENTER
*
*                  S O L U T E   version 3.0
*
*    ANALYTICAL MODELS FOR SOLUTE TRANSPORT
*
**************************************************************
```

Model: ONEd-3 **BASE CASE MODEL**

PROJECT......... = IAWC-Webb
USER NAME....... = WHPA-Inc.
DATE............ = 06-24-97
DATA FILE....... = f-base.dat

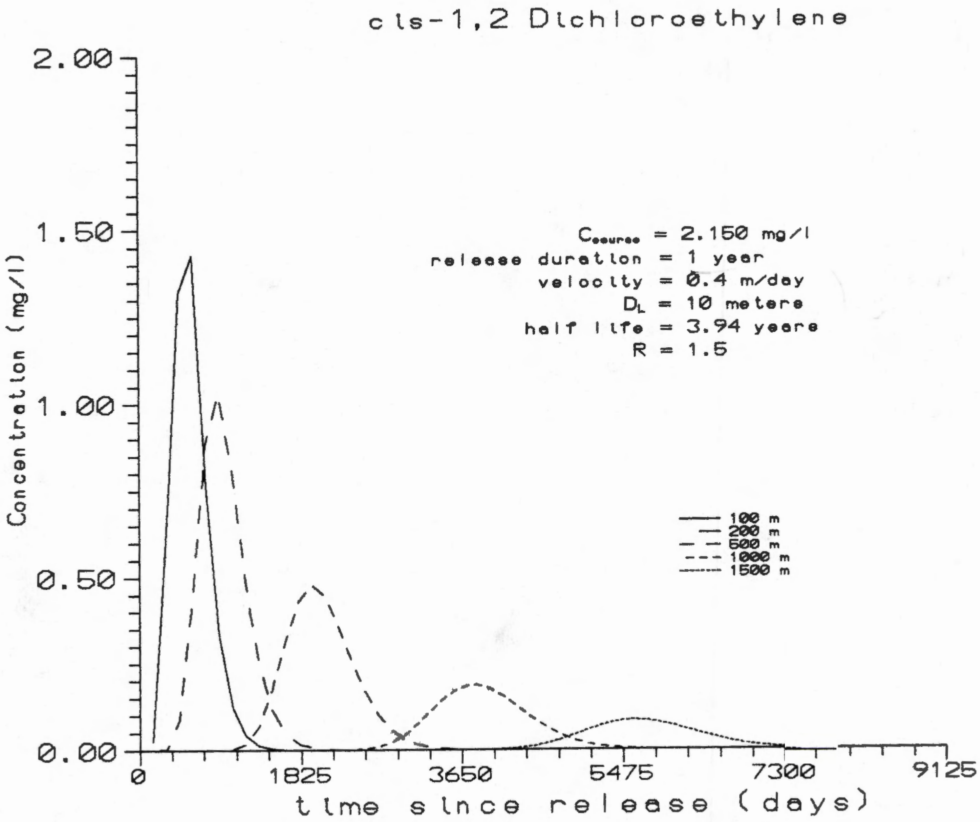
INPUT DATA:

GROUNDWATER (SEEPAGE) VELOCITY = 0.4 [m/d] held constant for all runs
LONGITUDINAL DISPERSIVITY..... = 10 [m]
? DL RETARDATION FACTOR............ = 1.5
INITIAL CONCENTRATION......... = 0 [mg/l]
CONCENTRATION AT SOURCE....... = 2.21 [mg/l] DCE 100 g/l TCE 20,000
LENGTH OF TIME STEP........... = 182 [d]
NUMBER OF TIME STEPS.......... = 50
NUMBER OF OBSERVATION POINTS.. = 5
1 DISTANCE (from source). = 100 [m]
2 DISTANCE (from source). = 200 [m]
3 DISTANCE (from source). = 500 [m]
4 DISTANCE (from source). = 1000 [m]
5 DISTANCE (from source). = 1500 [m] Wells Field
DURATION OF SOLUTE PULSE...... = 1825 [d] varied varied – 365, 2875
HALF-LIFE (0 if no decay)..... = 1450 [d]
DECAY CONSTANT (lambda)....... = .4780D-03 [1/d] varied

CONCENTRATION C [mg/l]

| TIME [d] | 1 DISTANCE 100.00 [m] | 2 DISTANCE 200.00 [m] | 3 DISTANCE 500.00 [m] | 4 DISTANCE 1000.00 [m] | 5 DISTANCE 1500.00 [m] |
|---|---|---|---|---|---|
| 182.0000 | 8.6569E-02 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| 364.0000 | 9.4367E-01 | 1.6564E-02 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| 546.0000 | 1.5980E+00 | 2.8457E-01 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| 728.0000 | 1.8409E+00 | 8.4202E-01 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| 910.0000 | 1.9136E+00 | 1.3085E+00 | 1.6077E-04 | 0.0000E+00 | 0.0000E+00 |
| 1092.0000 | 1.9337E+00 | 1.5594E+00 | 4.5473E-03 | 0.0000E+00 | 0.0000E+00 |
| 1274.0000 | 1.9390E+00 | 1.6659E+00 | 3.7444E-02 | 0.0000E+00 | 0.0000E+00 |
| 1456.0000 | 1.9404E+00 | 1.7052E+00 | 1.4453E-01 | 0.0000E+00 | 0.0000E+00 |
| 1638.0000 | 1.9407E+00 | 1.7185E+00 | 3.4238E-01 | 0.0000E+00 | 0.0000E+00 |
| 1820.0000 | 1.9408E+00 | 1.7228E+00 | 5.8777E-01 | 0.0000E+00 | 0.0000E+00 |
| 2002.0000 | 1.8663E+00 | 1.7241E+00 | 8.1564E-01 | 0.0000E+00 | 0.0000E+00 |

| | | | | | |
|---|---|---|---|---|---|
| 2184.0000 | 1.0224E+00 | 1.7099E+00 | 9.8620E-01 | 5.6812E-05 | 0.0000E+00 |
| 2366.0000 | 3.5413E-01 | 1.4529E+00 | 1.0945E+00 | 5.1267E-04 | 0.0000E+00 |
| 2548.0000 | 1.0350E-01 | 8.9812E-01 | 1.1550E+00 | 2.8980E-03 | 0.0000E+00 |
| 2730.0000 | 2.8262E-02 | 4.2601E-01 | 1.1854E+00 | 1.1309E-02 | 0.0000E+00 |
| 2912.0000 | 7.4920E-03 | 1.6982E-01 | 1.1955E+00 | 3.2804E-02 | 0.0000E+00 |
| 3094.0000 | 1.9599E-03 | 6.0555E-02 | 1.1702E+00 | 7.4907E-02 | 0.0000E+00 |
| 3276.0000 | 5.0990E-04 | 2.0066E-02 | 1.0682E+00 | 1.4097E-01 | 0.0000E+00 |
| 3458.0000 | 1.3245E-04 | 6.3258E-03 | 8.7347E-01 | 2.2696E-01 | 0.0000E+00 |
| 3640.0000 | 3.4422E-05 | 1.9260E-03 | 6.2887E-01 | 3.2246E-01 | 4.9284E-05 |
| 3822.0000 | 0.0000E+00 | 5.7190E-04 | 3.9996E-01 | 4.1504E-01 | 2.4641E-04 |
| 4004.0000 | 0.0000E+00 | 1.6673E-04 | 2.2767E-01 | 4.9481E-01 | 9.6283E-04 |
| 4186.0000 | 0.0000E+00 | 4.7948E-05 | 1.1782E-01 | 5.5655E-01 | 3.0414E-03 |
| 4368.0000 | 0.0000E+00 | 1.3634E-05 | 5.6262E-02 | 5.9856E-01 | 7.9920E-03 |
| 4550.0000 | 0.0000E+00 | 0.0000E+00 | 2.5107E-02 | 6.1961E-01 | 1.7901E-02 |
| 4732.0000 | 0.0000E+00 | 0.0000E+00 | 1.0585E-02 | 6.1655E-01 | 3.4908E-02 |
| 4914.0000 | 0.0000E+00 | 0.0000E+00 | 4.2527E-03 | 5.8549E-01 | 6.0362E-02 |
| 5096.0000 | 0.0000E+00 | 0.0000E+00 | 1.6403E-03 | 5.2577E-01 | 9.4081E-02 |
| 5278.0000 | 0.0000E+00 | 0.0000E+00 | 6.1106E-04 | 4.4319E-01 | 1.3411E-01 |
| 5460.0000 | 0.0000E+00 | 0.0000E+00 | 2.2093E-04 | 3.4927E-01 | 1.7714E-01 |
| 5642.0000 | 0.0000E+00 | 0.0000E+00 | 7.7842E-05 | 2.5718E-01 | 2.1936E-01 |
| 5824.0000 | 0.0000E+00 | 0.0000E+00 | 2.6819E-05 | 1.7724E-01 | 2.5717E-01 |
| 6006.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 1.1471E-01 | 2.8766E-01 |
| 6188.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 7.0011E-02 | 3.0849E-01 |
| 6370.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 4.0469E-02 | 3.1783E-01 |
| 6552.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 2.2252E-02 | 3.1445E-01 |
| 6734.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 1.1688E-02 | 2.9819E-01 |
| 6916.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 5.8879E-03 | 2.7039E-01 |
| 7098.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 2.8546E-03 | 2.3397E-01 |
| 7280.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 1.3365E-03 | 1.9297E-01 |
| 7462.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 6.0599E-04 | 1.5165E-01 |
| 7644.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 2.6684E-04 | 1.1363E-01 |
| 7826.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 1.1438E-04 | 8.1265E-02 |
| 8008.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 4.7834E-05 | 5.5570E-02 |
| 8190.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 1.9555E-05 | 3.6402E-02 |
| 8372.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 2.2892E-02 |
| 8554.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 1.3850E-02 |
| 8736.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 8.0795E-03 |
| 8918.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 4.5538E-03 |
| 9100.0000 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 2.4849E-03 |



cis-1,2 Dichloroethylene
2.00
1.50
1.00
0.50
0.00
Concentration (mg/l)
0
1825
3650
5475
7300
9125
time since release (days)
$C_{source}$ = 2.150 mg/l
release duration = 1 year
velocity = 0.4 m/day
$D_L$ = 10 meters
half life = 3.94 years
R = 1.5
100 m
200 m
500 m
1000 m
1500 m

```
*****************************************************************
*
*    INTERNATIONAL GROUND WATER MODELING CENTER
*
*                    S O L U T E   version 3.0
*
*    ANALYTICAL MODELS FOR SOLUTE TRANSPORT
*
*****************************************************************
```

Model: ONEd-3

PROJECT......... = IAWC-Webb
USER NAME....... = WHPA-Inc.
DATE............ = 06-24-97
DATA FILE....... = fbt2.dat

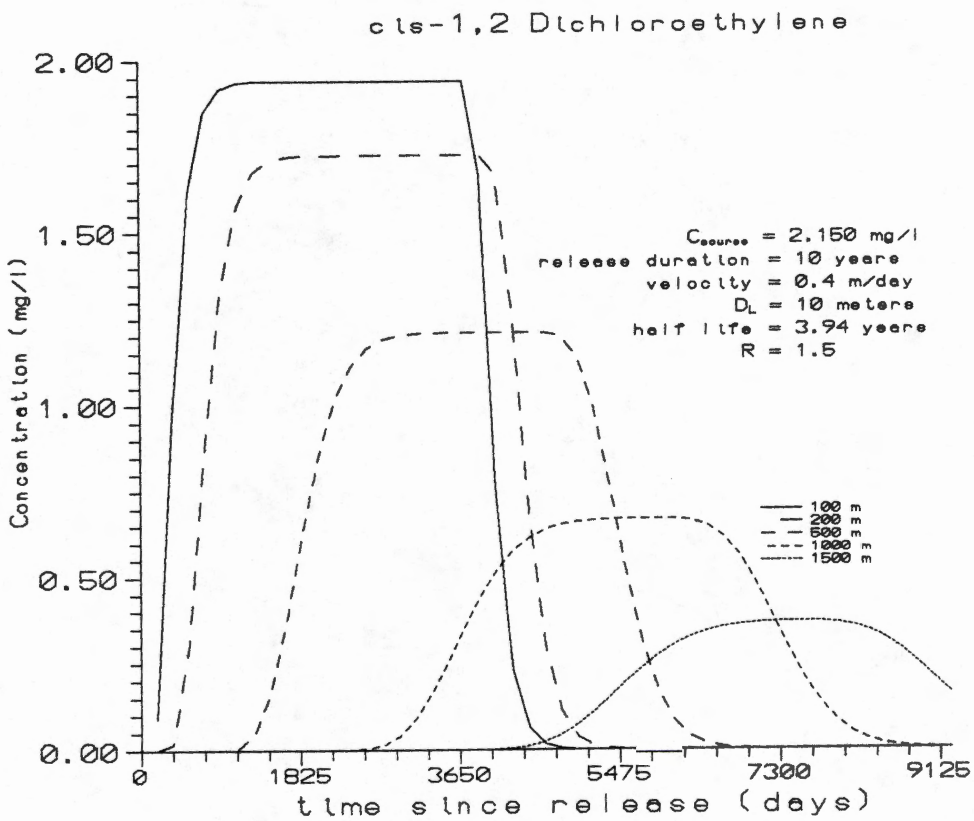
INPUT DATA:

GROUNDWATER (SEEPAGE) VELOCITY = .4 [m/d]
LONGITUDINAL DISPERSIVITY..... = 10 [m]
RETARDATION FACTOR............ = 1.5
INITIAL CONCENTRATION......... = 0 [mg/l]
CONCENTRATION AT SOURCE....... = 2.21 [mg/l]
LENGTH OF TIME STEP........... = 150 [d]
NUMBER OF TIME STEPS.......... = 50
NUMBER OF OBSERVATION POINTS.. = 5
1 DISTANCE (from source). = 100 [m]
2 DISTANCE (from source). = 200 [m]
3 DISTANCE (from source). = 500 [m]
4 DISTANCE (from source). = 1000 [m]
5 DISTANCE (from source). = 1500 [m]
***DURATION OF SOLUTE PULSE...... = 365 [d]***
HALF-LIFE (0 if no decay)..... = 1450 [d]
DECAY CONSTANT (lambda)....... = .4780D-03 [1/d]

CONCENTRATION C [mg/l]

| TIME [d] | 1 DISTANCE 100.00 [m] | 2 DISTANCE 200.00 [m] | 3 DISTANCE 500.00 [m] | 4 DISTANCE 1000.00 [m] | 5 DISTANCE 1500.00 [m] |
|---|---|---|---|---|---|
| 150.0000 | 2.7797E-02 | 8.8285E-09 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| 300.0000 | 6.0464E-01 | 2.1653E-03 | 4.0956E-26 | 0.0000E+00 | 0.0000E+00 |
| 450.0000 | 1.3190E+00 | 9.1045E-02 | 5.1685E-15 | 0.0000E+00 | 0.0000E+00 |
| 600.0000 | 1.4262E+00 | 4.3724E-01 | 1.2323E-09 | 0.0000E+00 | 0.0000E+00 |
| 750.0000 | 8.0920E-01 | 8.8168E-01 | 1.4862E-06 | 5.4530E-37 | 0.0000E+00 |
| 900.0000 | 3.3875E-01 | 1.0320E+00 | 1.2716E-04 | 2.7622E-28 | 0.0000E+00 |
| 1050.0000 | 1.2500E-01 | 8.1145E-01 | 2.4027E-03 | 3.5037E-22 | 0.0000E+00 |
| 1200.0000 | 4.3528E-02 | 4.9147E-01 | 1.7748E-02 | 1.0490E-17 | 0.0000E+00 |
| 1350.0000 | 1.4728E-02 | 2.5192E-01 | 7.0059E-02 | 2.5814E-14 | 1.6898E-41 |
| 1500.0000 | 4.9102E-03 | 1.1578E-01 | 1.7660E-01 | 1.1044E-11 | 4.2083E-35 |
| 1650.0000 | 1.6246E-03 | 4.9422E-02 | 3.1646E-01 | 1.3239E-09 | 6.0390E-30 |

| | | | | | |
|---|---|---|---|---|---|
| 1800.0000 | 5.3558E-04 | 2.0035E-02 | 4.3329E-01 | 6.1153E-08 | 1.0187E-25 |
| 1950.0000 | 1.7632E-04 | 7.8264E-03 | 4.7835E-01 | 1.3575E-06 | 3.3098E-22 |
| 2100.0000 | 5.8052E-05 | 2.9748E-03 | 4.4401E-01 | 1.6966E-05 | 2.9474E-19 |
| 2250.0000 | 1.9126E-05 | 1.1077E-03 | 3.5809E-01 | 1.3377E-04 | 9.3193E-17 |
| 2400.0000 | 6.2997E-06 | 4.0606E-04 | 2.5750E-01 | 7.2570E-04 | 1.2706E-14 |
| 2550.0000 | 2.0800E-06 | 1.4706E-04 | 1.6851E-01 | 2.8895E-03 | 8.6674E-13 |
| 2700.0000 | 6.8783E-07 | 5.2752E-05 | 1.0199E-01 | 8.8727E-03 | 3.3207E-11 |
| 2850.0000 | 2.2782E-07 | 1.8779E-05 | 5.7826E-02 | 2.1839E-02 | 7.8290E-10 |
| 3000.0000 | 7.5578E-08 | 6.6367E-06 | 3.1031E-02 | 4.4439E-02 | 1.2220E-08 |
| 3150.0000 | 2.5112E-08 | 2.3359E-06 | 1.5893E-02 | 7.6663E-02 | 1.3394E-07 |
| 3300.0000 | 8.3574E-09 | 8.1885E-07 | 7.8217E-03 | 1.1449E-01 | 1.0820E-06 |
| 3450.0000 | 2.7854E-09 | 2.8610E-07 | 3.7196E-03 | 1.5063E-01 | 6.7052E-06 |
| 3600.0000 | 9.2974E-10 | 9.9688E-08 | 1.7171E-03 | 1.7722E-01 | 3.2892E-05 |
| 3750.0000 | 3.1076E-10 | 3.4658E-08 | 7.7244E-04 | 1.8885E-01 | 1.3139E-04 |
| 3900.0000 | 1.0401E-10 | 1.2027E-08 | 3.3971E-04 | 1.8428E-01 | 4.3735E-04 |
| 4050.0000 | 3.4858E-11 | 4.1671E-09 | 1.4646E-04 | 1.6625E-01 | 1.2370E-03 |
| 4200.0000 | 1.1696E-11 | 1.4420E-09 | 6.2047E-05 | 1.3980E-01 | 3.0227E-03 |
| 4350.0000 | 3.9293E-12 | 4.9845E-10 | 2.5877E-05 | 1.1038E-01 | 6.4743E-03 |
| 4500.0000 | 1.3209E-12 | 1.7215E-10 | 1.0643E-05 | 8.2332E-02 | 1.2308E-02 |
| 4650.0000 | 4.4461E-13 | 5.9413E-11 | 4.3187E-06 | 5.8342E-02 | 2.0998E-02 |
| 4800.0000 | 1.4999E-13 | 2.0493E-11 | 1.7343E-06 | 3.9465E-02 | 3.2458E-02 |
| 4950.0000 | 5.0586E-14 | 7.0653E-12 | 6.8950E-07 | 2.5593E-02 | 4.5851E-02 |
| 5100.0000 | 1.7183E-14 | 2.4344E-12 | 2.7163E-07 | 1.5972E-02 | 5.9646E-02 |
| 5250.0000 | 5.8033E-15 | 8.3899E-13 | 1.0613E-07 | 9.6242E-03 | 7.1940E-02 |
| 5400.0000 | 1.8542E-15 | 2.8890E-13 | 4.1154E-08 | 5.6162E-03 | 8.0939E-02 |
| 5550.0000 | 6.2743E-16 | 9.9612E-14 | 1.5850E-08 | 3.1824E-03 | 8.5413E-02 |
| 5700.0000 | 5.8081E-16 | 3.4056E-14 | 6.0664E-09 | 1.7553E-03 | 8.4960E-02 |
| 5850.0000 | -1.0864E-16 | 1.1986E-14 | 2.3085E-09 | 9.4432E-04 | 8.0014E-02 |
| 6000.0000 | -1.0864E-16 | 4.0878E-15 | 8.7392E-10 | 4.9651E-04 | 7.1636E-02 |
| 6150.0000 | -1.0864E-16 | 1.3889E-15 | 3.2924E-10 | 2.5558E-04 | 6.1193E-02 |
| 6300.0000 | -1.0864E-16 | 1.6209E-16 | 1.2348E-10 | 1.2900E-04 | 5.0039E-02 |
| 6450.0000 | -1.0864E-16 | 1.3878E-16 | 4.6124E-11 | 6.3937E-05 | 3.9291E-02 |
| 6600.0000 | -1.0864E-16 | -1.0658E-16 | 1.7163E-11 | 3.1161E-05 | 2.9705E-02 |
| 6750.0000 | -1.0864E-16 | -1.0658E-16 | 6.3644E-12 | 1.4948E-05 | 2.1678E-02 |
| 6900.0000 | -1.0864E-16 | -1.0658E-16 | 2.3517E-12 | 7.0658E-06 | 1.5307E-02 |
| 7050.0000 | -1.0864E-16 | -1.0658E-16 | 8.6667E-13 | 3.2912E-06 | 1.0479E-02 |
| 7200.0000 | -1.0864E-16 | -1.0658E-16 | 3.1846E-13 | 1.5147E-06 | 6.9693E-03 |
| 7350.0000 | -1.0864E-16 | -1.0658E-16 | 1.1673E-13 | 6.8872E-07 | 4.5108E-03 |
| 7500.0000 | -1.0864E-16 | -1.0658E-16 | 4.2623E-14 | 3.0966E-07 | 2.8461E-03 |


cis-1,2 Dichloroethylene
2.00
1.50
1.00
0.50
0.00
Concentration ( mg/l)
0
1825
3650
5475
7300
9125
time since release (days)
$C_{source}$ = 2.150 mg/l
release duration = 10 years
velocity = 0.4 m/day
$D_L$ = 10 meters
half life = 3.94 years
R = 1.5
100 m
200 m
500 m
1000 m
1500 m

```
****************************************************************
*
*   INTERNATIONAL GROUND WATER MODELING CENTER
*
*                  S O L U T E   version 3.0
*
*    ANALYTICAL MODELS FOR SOLUTE TRANSPORT
*
****************************************************************
```

Model: ONEd-3

PROJECT......... = IAWC-Webb
USER NAME....... = WHPA-Inc.
DATE............ = 06-24-97
DATA FILE....... = fbt4.dat

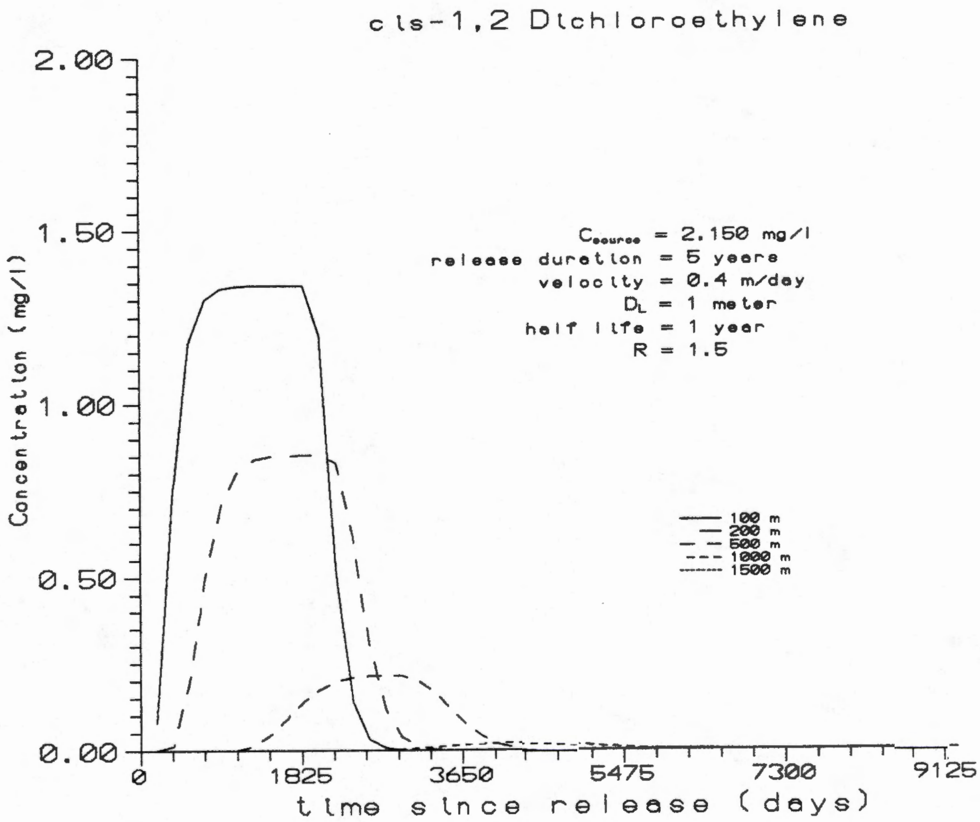
INPUT DATA:

GROUNDWATER (SEEPAGE) VELOCITY = .4 [m/d]
LONGITUDINAL DISPERSIVITY..... = 10 [m]
RETARDATION FACTOR............ = 1.5
INITIAL CONCENTRATION......... = 0 [mg/l]
CONCENTRATION AT SOURCE....... = 2.21 [mg/l]
LENGTH OF TIME STEP........... = 210 [d]
NUMBER OF TIME STEPS.......... = 50
NUMBER OF OBSERVATION POINTS.. = 5
1 DISTANCE (from source). = 100 [m]
2 DISTANCE (from source). = 200 [m]
3 DISTANCE (from source). = 500 [m]
4 DISTANCE (from source). = 1000 [m]
5 DISTANCE (from source). = 1500 [m]
***DURATION OF SOLUTE PULSE...... = 3650 [d]***
HALF-LIFE (0 if no decay)..... = 1450 [d]
DECAY CONSTANT (lambda)....... = .4780D-03 [1/d]

CONCENTRATION C [mg/l]

| TIME [d] | 1 DISTANCE 100.00 [m] | 2 DISTANCE 200.00 [m] | 3 DISTANCE 500.00 [m] | 4 DISTANCE 1000.00 [m] | 5 DISTANCE 1500.00 [m] |
|---|---|---|---|---|---|
| 210.0000 | 1.7266E-01 | 1.1635E-05 | 1.3378E-40 | 0.0000E+00 | 0.0000E+00 |
| 420.0000 | 1.2018E+00 | 5.5290E-02 | 1.4018E-16 | 0.0000E+00 | 0.0000E+00 |
| 630.0000 | 1.7444E+00 | 5.3026E-01 | 6.8912E-09 | 0.0000E+00 | 0.0000E+00 |
| 840.0000 | 1.8957E+00 | 1.1550E+00 | 2.6920E-05 | 2.2361E-31 | 0.0000E+00 |
| 1050.0000 | 1.9310E+00 | 1.5177E+00 | 2.4028E-03 | 3.5037E-22 | 0.0000E+00 |
| 1260.0000 | 1.9388E+00 | 1.6608E+00 | 3.2851E-02 | 3.0603E-16 | 0.0000E+00 |
| 1470.0000 | 1.9404E+00 | 1.7068E+00 | 1.5674E-01 | 3.6854E-12 | 2.8585E-36 |
| 1680.0000 | 1.9408E+00 | 1.7200E+00 | 3.9724E-01 | 3.0502E-09 | 4.9295E-29 |
| 1890.0000 | 1.9409E+00 | 1.7235E+00 | 6.8050E-01 | 4.2419E-07 | 1.5490E-23 |
| 2100.0000 | 1.9409E+00 | 1.7244E+00 | 9.1559E-01 | 1.6978E-05 | 2.9474E-19 |
| 2310.0000 | 1.9409E+00 | 1.7246E+00 | 1.0671E+00 | 2.7530E-04 | 7.2961E-16 |

| | | | | | |
|---|---|---|---|---|---|
| 2520.0000 | 1.9409E+00 | 1.7246E+00 | 1.1481E+00 | 2.2791E-03 | 3.9138E-13 |
| 2730.0000 | 1.9409E+00 | 1.7246E+00 | 1.1855E+00 | 1.1309E-02 | 6.4789E-11 |
| 2940.0000 | 1.9409E+00 | 1.7246E+00 | 1.2011E+00 | 3.7784E-02 | 4.2621E-09 |
| 3150.0000 | 1.9409E+00 | 1.7247E+00 | 1.2070E+00 | 9.2715E-02 | 1.3415E-07 |
| 3360.0000 | 1.9409E+00 | 1.7247E+00 | 1.2091E+00 | 1.7870E-01 | 2.3232E-06 |
| 3570.0000 | 1.9409E+00 | 1.7247E+00 | 1.2098E+00 | 2.8541E-01 | 2.4645E-05 |
| 3780.0000 | 1.9308E+00 | 1.7247E+00 | 1.2100E+00 | 3.9452E-01 | 1.7396E-04 |
| 3990.0000 | 1.1209E+00 | 1.7161E+00 | 1.2100E+00 | 4.8932E-01 | 8.7391E-04 |
| 4200.0000 | 3.3414E-01 | 1.4296E+00 | 1.2101E+00 | 5.6106E-01 | 3.2964E-03 |
| 4410.0000 | 7.9792E-02 | 7.8593E-01 | 1.2101E+00 | 6.0929E-01 | 9.7561E-03 |
| 4620.0000 | 1.7631E-02 | 3.1171E-01 | 1.2095E+00 | 6.3857E-01 | 2.3502E-02 |
| 4830.0000 | 3.7798E-03 | 1.0138E-01 | 1.1959E+00 | 6.5486E-01 | 4.7534E-02 |
| 5040.0000 | 8.0097E-04 | 2.9245E-02 | 1.1153E+00 | 6.6323E-01 | 8.2911E-02 |
| 5250.0000 | 1.6913E-04 | 7.8216E-03 | 9.1509E-01 | 6.6727E-01 | 1.2767E-01 |
| 5460.0000 | 3.5720E-05 | 1.9907E-03 | 6.3588E-01 | 6.6909E-01 | 1.7719E-01 |
| 5670.0000 | 7.5494E-06 | 4.8985E-04 | 3.7470E-01 | 6.6987E-01 | 2.2584E-01 |
| 5880.0000 | 1.6011E-06 | 1.1773E-04 | 1.9102E-01 | 6.7009E-01 | 2.6881E-01 |
| 6090.0000 | 3.4060E-07 | 2.7820E-05 | 8.6270E-02 | 6.6924E-01 | 3.0332E-01 |
| 6300.0000 | 7.2686E-08 | 6.4863E-06 | 3.5275E-02 | 6.6390E-01 | 3.2877E-01 |
| 6510.0000 | 1.5559E-08 | 1.4994E-06 | 1.3295E-02 | 6.4554E-01 | 3.4613E-01 |
| 6720.0000 | 3.3407E-09 | 3.4422E-07 | 4.6870E-03 | 6.0241E-01 | 3.5718E-01 |
| 6930.0000 | 7.1932E-10 | 7.8606E-08 | 1.5634E-03 | 5.2772E-01 | 3.6378E-01 |
| 7140.0000 | 1.5530E-10 | 1.7878E-08 | 4.9803E-04 | 4.2698E-01 | 3.6749E-01 |
| 7350.0000 | 3.3614E-11 | 4.0534E-09 | 1.5264E-04 | 3.1653E-01 | 3.6941E-01 |
| 7560.0000 | 7.2927E-12 | 9.1685E-10 | 4.5277E-05 | 2.1475E-01 | 3.7001E-01 |
| 7770.0000 | 1.5859E-12 | 2.0700E-10 | 1.3062E-05 | 1.3377E-01 | 3.6895E-01 |
| 7980.0000 | 3.4536E-13 | 4.6670E-11 | 3.6757E-06 | 7.6943E-02 | 3.6461E-01 |
| 8190.0000 | 7.5217E-14 | 1.0511E-11 | 1.0140E-06 | 4.1130E-02 | 3.5414E-01 |
| 8400.0000 | 1.6330E-14 | 2.3652E-12 | 2.7474E-07 | 2.0570E-02 | 3.3434E-01 |
| 8610.0000 | 3.3263E-15 | 5.3183E-13 | 7.3288E-08 | 9.6867E-03 | 3.0325E-01 |
| 8820.0000 | 6.2743E-16 | 1.1987E-13 | 1.9284E-08 | 4.3203E-03 | 2.6165E-01 |
| 9030.0000 | 1.3672E-16 | 2.6883E-14 | 5.0128E-09 | 1.8348E-03 | 2.1329E-01 |
| 9240.0000 | -1.0864E-16 | 6.0274E-15 | 1.2892E-09 | 7.4555E-04 | 1.6366E-01 |
| 9450.0000 | -1.0864E-16 | 1.3656E-15 | 3.2844E-10 | 2.9109E-04 | 1.1807E-01 |
| 9660.0000 | -1.0864E-16 | 3.8413E-16 | 8.2964E-11 | 1.0962E-04 | 8.0156E-02 |
| 9870.0000 | -1.0864E-16 | -1.0658E-16 | 2.0798E-11 | 3.9954E-05 | 5.1305E-02 |
| 10080.0000 | -1.0864E-16 | -1.0658E-16 | 5.1783E-12 | 1.4135E-05 | 3.1046E-02 |
| 10290.0000 | -1.0864E-16 | -1.0658E-16 | 1.2813E-12 | 4.8630E-06 | 1.7816E-02 |
| 10500.0000 | -1.0864E-16 | -1.0658E-16 | 3.1529E-13 | 1.6331E-06 | 9.7270E-03 |


cis-1,2 Dichloroethylene
2.00
1.50
1.00
0.50
0.00
Concentration (mg/l)
$C_{source}$ = 2.150 mg/l
release duration = 5 years
velocity = 0.4 m/day
$D_L$ = 1 meter
half life = 1 year
R = 1.5
100 m
200 m
500 m
1000 m
1500 m
0
1825
3650
5475
7300
9125
time since release (days)

```
****************************************************************
*
*    INTERNATIONAL GROUND WATER MODELING CENTER
*
*                  S O L U T E  version 3.0
*
*    ANALYTICAL MODELS FOR SOLUTE TRANSPORT
*
****************************************************************
```

Model: ONEd-3

PROJECT......... = IAWC-Webb
USER NAME....... = WHPA-Inc.
DATE............ = 06-24-97
DATA FILE....... = fbl2.dat

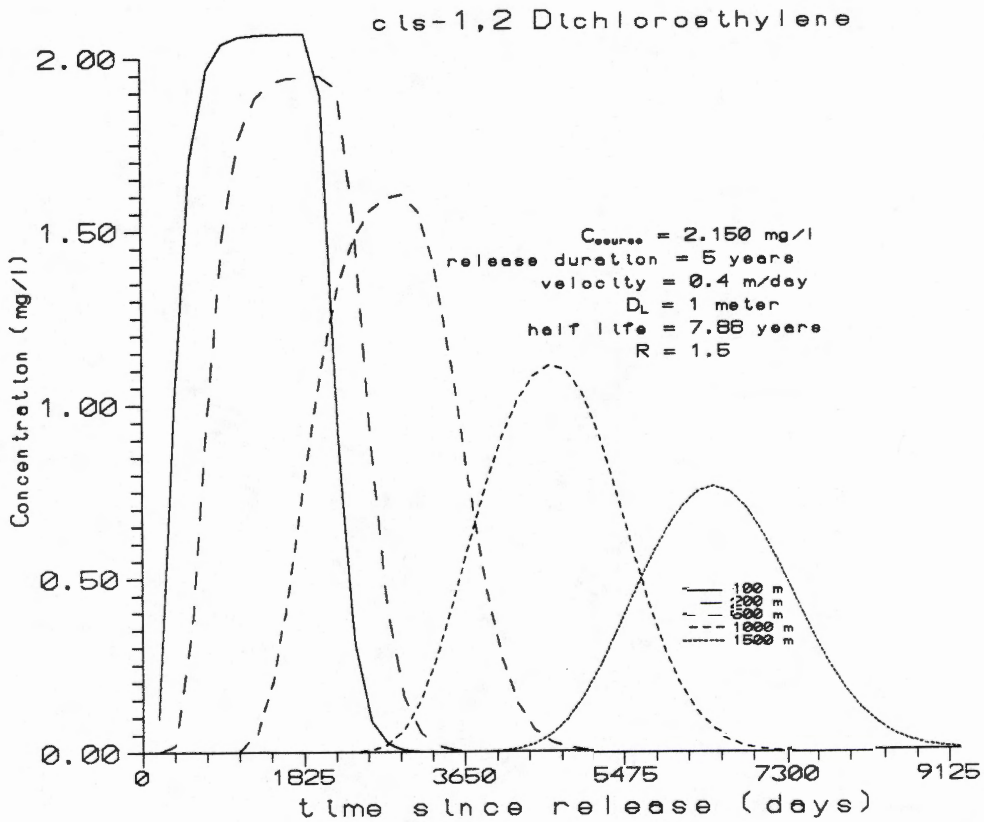
INPUT DATA:

GROUNDWATER (SEEPAGE) VELOCITY = .4 [m/d]
LONGITUDINAL DISPERSIVITY..... = 10 [m]
RETARDATION FACTOR............ = 1.5
INITIAL CONCENTRATION......... = 0 [mg/l]
CONCENTRATION AT SOURCE....... = 2.21 [mg/l]
LENGTH OF TIME STEP........... = 185 [d]
NUMBER OF TIME STEPS.......... = 50
NUMBER OF OBSERVATION POINTS.. = 5
  1 DISTANCE (from source). = 100 [m]
  2 DISTANCE (from source). = 200 [m]
  3 DISTANCE (from source). = 500 [m]
  4 DISTANCE (from source). = 1000 [m]
  5 DISTANCE (from source). = 1500 [m]
DURATION OF SOLUTE PULSE...... = 1825 [d]
***HALF-LIFE (0 if no decay)..... = 365 [d]***
DECAY CONSTANT (lambda)....... = .1899D-02 [1/d]

CONCENTRATION C [mg/l]

| TIME [d] | 1 DISTANCE 100.00 [m] | 2 DISTANCE 200.00 [m] | 3 DISTANCE 500.00 [m] | 4 DISTANCE 1000.00 [m] | 5 DISTANCE 1500.00 [m] |
|---|---|---|---|---|---|
| 185.0000 | 8.1116E-02 | 8.8219E-07 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| 370.0000 | 7.5336E-01 | 1.3992E-02 | 6.2588E-20 | 0.0000E+00 | 0.0000E+00 |
| 555.0000 | 1.1744E+00 | 1.9669E-01 | 3.8037E-11 | 0.0000E+00 | 0.0000E+00 |
| 740.0000 | 1.3021E+00 | 5.0553E-01 | 5.1982E-07 | 5.2862E-38 | 0.0000E+00 |
| 925.0000 | 1.3334E+00 | 7.1545E-01 | 9.7773E-05 | 1.6917E-27 | 0.0000E+00 |
| 1110.0000 | 1.3404E+00 | 8.0738E-01 | 2.1749E-03 | 1.1026E-20 | 0.0000E+00 |
| 1295.0000 | 1.3420E+00 | 8.3921E-01 | 1.4510E-02 | 5.5703E-16 | 8.4078E-45 |
| 1480.0000 | 1.3423E+00 | 8.4882E-01 | 4.6564E-02 | 1.3484E-12 | 1.7648E-36 |
| 1665.0000 | 1.3424E+00 | 8.5148E-01 | 9.4086E-02 | 4.3088E-10 | 3.6489E-30 |
| 1850.0000 | 1.3424E+00 | 8.5218E-01 | 1.4156E-01 | 3.3426E-08 | 3.1313E-25 |

| | | | | | |
|---|---|---|---|---|---|
| 2035.0000 | 1.1963E+00 | 8.5234E-01 | 1.7719E-01 | 9.2891E-07 | 2.6554E-21 |
| 2220.0000 | 5.0618E-01 | 8.2818E-01 | 1.9879E-01 | 1.1979E-05 | 3.9694E-18 |
| 2405.0000 | 1.3938E-01 | 6.1496E-01 | 2.0992E-01 | 8.6009E-05 | 1.5618E-15 |
| 2590.0000 | 3.2973E-02 | 3.1033E-01 | 2.1497E-01 | 3.9167E-04 | 2.1542E-13 |
| 2775.0000 | 7.3416E-03 | 1.1888E-01 | 2.1689E-01 | 1.2465E-03 | 1.2857E-11 |
| 2960.0000 | 1.5922E-03 | 3.8358E-02 | 2.1486E-01 | 2.9859E-03 | 3.8889E-10 |
| 3145.0000 | 3.4135E-04 | 1.1109E-02 | 2.0052E-01 | 5.7083E-03 | 6.7289E-09 |
| 3330.0000 | 7.2852E-05 | 2.9980E-03 | 1.6584E-01 | 9.1313E-03 | 7.3240E-08 |
| 3515.0000 | 1.5534E-05 | 7.7139E-04 | 1.1738E-01 | 1.2710E-02 | 5.3977E-07 |
| 3700.0000 | 3.3102E-06 | 1.9197E-04 | 7.1039E-02 | 1.5910E-02 | 2.8636E-06 |
| 3885.0000 | 7.0721E-07 | 4.6648E-05 | 3.7373E-02 | 1.8410E-02 | 1.1487E-05 |
| 4070.0000 | 1.5142E-07 | 1.1139E-05 | 1.7456E-02 | 2.0138E-02 | 3.6285E-05 |
| 4255.0000 | 3.2498E-08 | 2.6220E-06 | 7.3836E-03 | 2.1144E-02 | 9.3395E-05 |
| 4440.0000 | 6.9916E-09 | 6.1156E-07 | 2.8769E-03 | 2.1419E-02 | 2.0165E-04 |
| 4625.0000 | 1.5078E-09 | 1.4155E-07 | 1.0471E-03 | 2.0800E-02 | 3.7455E-04 |
| 4810.0000 | 3.2595E-10 | 3.2568E-08 | 3.6003E-04 | 1.9095E-02 | 6.1180E-04 |
| 4995.0000 | 7.0623E-11 | 7.4586E-09 | 1.1802E-04 | 1.6332E-02 | 8.9627E-04 |
| 5180.0000 | 1.5335E-11 | 1.7019E-09 | 3.7160E-05 | 1.2889E-02 | 1.1986E-03 |
| 5365.0000 | 3.3367E-12 | 3.8719E-10 | 1.1305E-05 | 9.3485E-03 | 1.4866E-03 |
| 5550.0000 | 7.2759E-13 | 8.7889E-11 | 3.3398E-06 | 6.2367E-03 | 1.7338E-03 |
| 5735.0000 | 1.5885E-13 | 1.9914E-11 | 9.6105E-07 | 3.8415E-03 | 1.9220E-03 |
| 5920.0000 | 3.5185E-14 | 4.5054E-12 | 2.7070E-07 | 2.1964E-03 | 2.0392E-03 |
| 6105.0000 | 7.4590E-15 | 1.0182E-12 | 7.4798E-08 | 1.1726E-03 | 2.0754E-03 |
| 6290.0000 | 1.8157E-15 | 2.2989E-13 | 2.0323E-08 | 5.8800E-04 | 2.0222E-03 |
| 6475.0000 | 5.8894E-16 | 5.1879E-14 | 5.4405E-09 | 2.7855E-04 | 1.8783E-03 |
| 6660.0000 | 3.4358E-16 | 1.1641E-14 | 1.4375E-09 | 1.2531E-04 | 1.6550E-03 |
| 6845.0000 | 3.4358E-16 | 2.6849E-15 | 3.7540E-10 | 5.3796E-05 | 1.3779E-03 |
| 7030.0000 | 9.8229E-17 | 4.7667E-16 | 9.7025E-11 | 2.2133E-05 | 1.0816E-03 |
| 7215.0000 | 9.8229E-17 | 2.3131E-16 | 2.4845E-11 | 8.7612E-06 | 8.0003E-04 |
| 7400.0000 | 9.8229E-17 | -1.4040E-17 | 6.3089E-12 | 3.3483E-06 | 5.5800E-04 |
| 7585.0000 | 9.8229E-17 | -1.4040E-17 | 1.5900E-12 | 1.2393E-06 | 3.6766E-04 |
| 7770.0000 | 9.8229E-17 | -1.4040E-17 | 3.9806E-13 | 4.4550E-07 | 2.2939E-04 |
| 7955.0000 | 9.8229E-17 | -1.4040E-17 | 9.9030E-14 | 1.5579E-07 | 1.3589E-04 |
| 8140.0000 | 9.8229E-17 | -1.4040E-17 | 2.4533E-14 | 5.3191E-08 | 7.6663E-05 |
| 8325.0000 | 9.8229E-17 | -1.4040E-17 | 6.0081E-15 | 1.7755E-08 | 4.1307E-05 |
| 8510.0000 | 9.8229E-17 | -1.4040E-17 | 1.4997E-15 | 5.8047E-09 | 2.1317E-05 |
| 8695.0000 | 9.8229E-17 | -1.4040E-17 | 3.9556E-16 | 1.8618E-09 | 1.0566E-05 |
| 8880.0000 | 9.8229E-17 | -1.4040E-17 | 1.1953E-16 | 5.8665E-10 | 5.0435E-06 |
| 9065.0000 | 9.8229E-17 | -1.4040E-17 | -3.1577E-18 | 1.8185E-10 | 2.3239E-06 |
| 9250.0000 | 9.8229E-17 | -1.4040E-17 | 2.7512E-17 | 5.5523E-11 | 1.0360E-06 |



cis-1,2 Dichloroethylene
2.00
1.50
1.00
0.50
0.00
Concentration (mg/l)
0
1825
3650
5475
7300
9125
time since release (days)
C source = 2.150 mg/l
release duration = 5 years
velocity = 0.4 m/day
D L = 1 meter
half life = 7.88 years
R = 1.5
100 m
200 m
500 m
1000 m
1500 m

```
***************************************************************
*
*    INTERNATIONAL GROUND WATER MODELING CENTER
*
*                 S O L U T E   version 3.0
*
*     ANALYTICAL MODELS FOR SOLUTE TRANSPORT
*
***************************************************************
```

Model: ONEd-3

PROJECT......... = IAWC-Webb
USER NAME....... = WHPA-Inc.
DATE............ = 06-24-97
DATA FILE....... = fbl3.dat

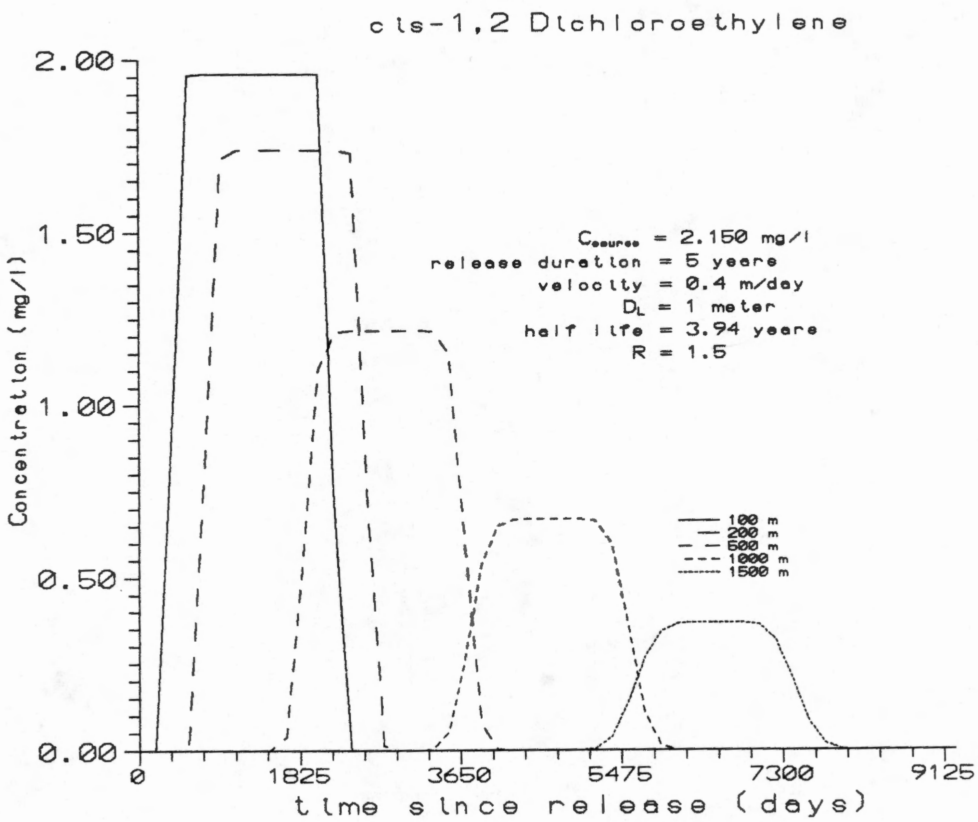
INPUT DATA:

GROUNDWATER (SEEPAGE) VELOCITY = .4 [m/d]
LONGITUDINAL DISPERSIVITY..... = 10 [m]
RETARDATION FACTOR............ = 1.5
INITIAL CONCENTRATION......... = 0 [mg/l]
CONCENTRATION AT SOURCE....... = 2.21 [mg/l]
LENGTH OF TIME STEP........... = 185 [d]
NUMBER OF TIME STEPS.......... = 50
NUMBER OF OBSERVATION POINTS.. = 5
  1 DISTANCE (from source). = 100 [m]
  2 DISTANCE (from source). = 200 [m]
  3 DISTANCE (from source). = 500 [m]
  4 DISTANCE (from source). = 1000 [m]
  5 DISTANCE (from source). = 1500 [m]
DURATION OF SOLUTE PULSE...... = 1825 [d]
***HALF-LIFE (0 if no decay)..... = 2875 [d]***
DECAY CONSTANT (lambda)....... = .2411D-03 [1/d]

CONCENTRATION C [mg/l]

| TIME [d] | 1 DISTANCE 100.00 [m] | 2 DISTANCE 200.00 [m] | 3 DISTANCE 500.00 [m] | 4 DISTANCE 1000.00 [m] | 5 DISTANCE 1500.00 [m] |
|---|---|---|---|---|---|
| 185.0000 | 9.6641E-02 | 1.0724E-06 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| 370.0000 | 1.0164E+00 | 2.0296E-02 | 9.3612E-20 | 0.0000E+00 | 0.0000E+00 |
| 555.0000 | 1.7077E+00 | 3.3239E-01 | 6.9219E-11 | 0.0000E+00 | 0.0000E+00 |
| 740.0000 | 1.9635E+00 | 9.6455E-01 | 1.1461E-06 | 1.1899E-37 | 0.0000E+00 |
| 925.0000 | 2.0402E+00 | 1.4863E+00 | 2.5978E-04 | 4.6538E-27 | 0.0000E+00 |
| 1110.0000 | 2.0614E+00 | 1.7652E+00 | 6.9128E-03 | 3.7032E-20 | 0.0000E+00 |
| 1295.0000 | 2.0671E+00 | 1.8834E+00 | 5.4648E-02 | 2.2812E-15 | 3.7835E-44 |
| 1480.0000 | 2.0685E+00 | 1.9271E+00 | 2.0511E-01 | 6.7238E-12 | 8.9513E-36 |
| 1665.0000 | 2.0689E+00 | 1.9419E+00 | 4.7662E-01 | 2.6120E-09 | 2.2628E-29 |
| 1850.0000 | 2.0690E+00 | 1.9467E+00 | 8.0750E-01 | 2.4582E-07 | 2.3726E-24 |
| 2035.0000 | 1.8915E+00 | 1.9481E+00 | 1.1108E+00 | 8.2641E-06 | 2.4570E-20 |

| | | | | | |
|---|---|---|---|---|---|
| 2220.0000 | 9.2628E-01 | 1.9127E+00 | 1.3358E+00 | 1.2867E-04 | 4.4819E-17 |
| 2405.0000 | 3.0795E-01 | 1.5400E+00 | 1.4776E+00 | 1.1104E-03 | 2.1501E-14 |
| 2590.0000 | 8.8862E-02 | 9.0023E-01 | 1.5566E+00 | 6.0499E-03 | 3.6129E-12 |
| 2775.0000 | 2.4216E-02 | 4.1150E-01 | 1.5958E+00 | 2.2900E-02 | 2.6241E-10 |
| 2960.0000 | 6.4364E-03 | 1.6046E-01 | 1.6050E+00 | 6.4766E-02 | 9.6468E-09 |
| 3145.0000 | 1.6921E-03 | 5.6507E-02 | 1.5550E+00 | 1.4483E-01 | 2.0258E-07 |
| 3330.0000 | 4.4299E-04 | 1.8604E-02 | 1.3907E+00 | 2.6792E-01 | 2.6703E-06 |
| 3515.0000 | 1.1588E-04 | 5.8503E-03 | 1.1075E+00 | 4.2535E-01 | 2.3815E-05 |
| 3700.0000 | 3.0339E-05 | 1.7814E-03 | 7.7611E-01 | 5.9761E-01 | 1.5239E-04 |
| 3885.0000 | 7.9476E-06 | 5.3001E-04 | 4.8173E-01 | 7.6249E-01 | 7.3516E-04 |
| 4070.0000 | 2.0882E-06 | 1.5503E-04 | 2.6863E-01 | 9.0296E-01 | 2.7833E-03 |
| 4255.0000 | 5.5001E-07 | 4.4772E-05 | 1.3670E-01 | 1.0102E+00 | 8.5502E-03 |
| 4440.0000 | 1.4521E-07 | 1.2794E-05 | 6.4410E-02 | 1.0810E+00 | 2.1922E-02 |
| 4625.0000 | 3.8431E-08 | 3.6308E-06 | 2.8445E-02 | 1.1119E+00 | 4.8050E-02 |
| 4810.0000 | 1.0195E-08 | 1.0244E-06 | 1.1897E-02 | 1.0963E+00 | 9.1933E-02 |
| 4995.0000 | 2.7106E-09 | 2.8772E-07 | 4.7521E-03 | 1.0282E+00 | 1.5635E-01 |
| 5180.0000 | 7.2226E-10 | 8.0522E-08 | 1.8255E-03 | 9.0937E-01 | 2.4020E-01 |
| 5365.0000 | 1.9284E-10 | 2.2471E-08 | 6.7823E-04 | 7.5368E-01 | 3.3818E-01 |
| 5550.0000 | 5.1585E-11 | 6.2570E-09 | 2.4487E-04 | 5.8369E-01 | 4.4200E-01 |
| 5735.0000 | 1.3825E-11 | 1.7391E-09 | 8.6249E-05 | 4.2249E-01 | 5.4236E-01 |
| 5920.0000 | 3.7116E-12 | 4.8266E-10 | 2.9733E-05 | 2.8649E-01 | 6.3073E-01 |
| 6105.0000 | 9.9788E-13 | 1.3381E-10 | 1.0050E-05 | 1.8267E-01 | 7.0003E-01 |
| 6290.0000 | 2.6867E-13 | 3.7064E-11 | 3.3436E-06 | 1.0998E-01 | 7.4460E-01 |
| 6475.0000 | 7.2629E-14 | 1.0260E-11 | 1.0963E-06 | 6.2800E-02 | 7.6009E-01 |
| 6660.0000 | 1.9631E-14 | 2.8385E-12 | 3.5485E-07 | 3.4161E-02 | 7.4405E-01 |
| 6845.0000 | 5.4000E-15 | 7.8508E-13 | 1.1355E-07 | 1.7775E-02 | 6.9710E-01 |
| 7030.0000 | 1.2291E-15 | 2.1708E-13 | 3.5964E-08 | 8.8803E-03 | 6.2378E-01 |
| 7215.0000 | 2.4763E-16 | 5.9802E-14 | 1.1287E-08 | 4.2750E-03 | 5.3223E-01 |
| 7400.0000 | 2.1684E-18 | 1.6374E-14 | 3.5132E-09 | 1.9894E-03 | 4.3269E-01 |
| 7585.0000 | 2.1684E-18 | 4.3512E-15 | 1.0854E-09 | 8.9747E-04 | 3.3520E-01 |
| 7770.0000 | 2.1684E-18 | 1.1615E-15 | 3.3311E-10 | 3.9354E-04 | 2.4766E-01 |
| 7955.0000 | 2.1684E-18 | 1.8009E-16 | 1.0161E-10 | 1.6812E-04 | 1.7475E-01 |
| 8140.0000 | 2.1684E-18 | -6.5269E-17 | 3.0823E-11 | 7.0122E-05 | 1.1798E-01 |
| 8325.0000 | 2.1684E-18 | -3.1062E-16 | 9.3025E-12 | 2.8610E-05 | 7.6366E-02 |
| 8510.0000 | 2.1684E-18 | -6.5269E-17 | 2.7951E-12 | 1.1430E-05 | 4.7491E-02 |
| 8695.0000 | 2.1684E-18 | -6.5269E-17 | 8.3636E-13 | 4.4836E-06 | 2.8438E-02 |
| 8880.0000 | 2.1684E-18 | -6.5269E-17 | 2.4922E-13 | 1.7285E-06 | 1.6433E-02 |
| 9065.0000 | 2.1684E-18 | -6.5269E-17 | 7.3784E-14 | 6.5572E-07 | 9.1819E-03 |
| 9250.0000 | 2.1684E-18 | -6.5269E-17 | 2.1768E-14 | 2.4506E-07 | 4.9710E-03 |



cis-1,2 Dichloroethylene
2.00
1.50
1.00
0.50
0.00
Concentration (mg/l)
$C_{source}$ = 2.150 mg/l
release duration = 5 years
velocity = 0.4 m/day
$D_L$ = 1 meter
half life = 3.94 years
R = 1.5
100 m
200 m
500 m
1000 m
1500 m
0
1825
3650
5475
7300
9125
time since release (days)

```
****************************************************************
*
*    INTERNATIONAL GROUND WATER MODELING CENTER
*
*                    S O L U T E   version 3.0
*
*    ANALYTICAL MODELS FOR SOLUTE TRANSPORT
*
****************************************************************
```

Model: ONEd-3

PROJECT......... = IAWC-Webb
USER NAME....... = WHPA-Inc.
DATE........... = 06-24-97
DATA FILE....... = fbd1.dat

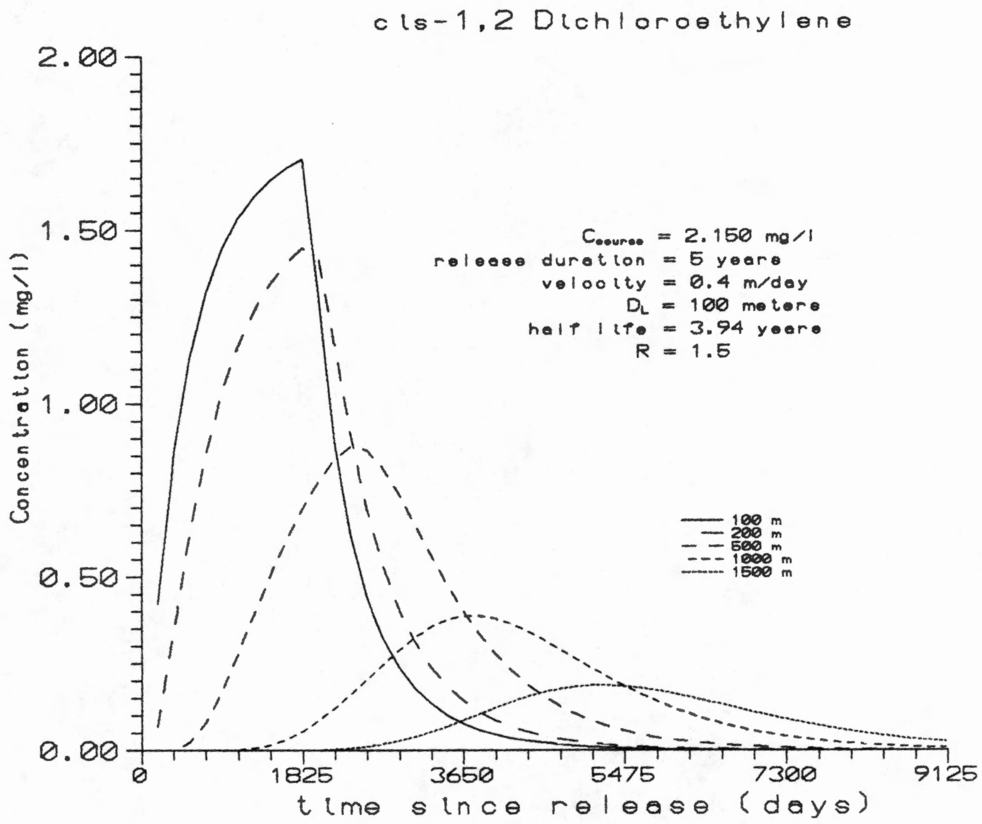
INPUT DATA:

GROUNDWATER (SEEPAGE) VELOCITY = .4 [m/d]
***LONGITUDINAL DISPERSIVITY..... = 1 [m]***
RETARDATION FACTOR............ = 1.5
INITIAL CONCENTRATION......... = 0 [mg/l]
CONCENTRATION AT SOURCE....... = 2.21 [mg/l]
LENGTH OF TIME STEP........... = 185 [d]
NUMBER OF TIME STEPS.......... = 50
NUMBER OF OBSERVATION POINTS.. = 5
1 DISTANCE (from source). = 100 [m]
2 DISTANCE (from source). = 200 [m]
3 DISTANCE (from source). = 500 [m]
4 DISTANCE (from source). = 1000 [m]
5 DISTANCE (from source). = 1500 [m]
DURATION OF SOLUTE PULSE...... = 1825 [d]
HALF-LIFE (0 if no decay)..... = 1450 [d]
DECAY CONSTANT (lambda)....... = .4780D-03 [1/d]

CONCENTRATION C [mg/l]

| TIME [d] | 1 DISTANCE 100.00 [m] | 2 DISTANCE 200.00 [m] | 3 DISTANCE 500.00 [m] | 4 DISTANCE 1000.00 [m] | 5 DISTANCE 1500.00 [m] |
|---|---|---|---|---|---|
| 185.0000 | 3.1025E-07 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| 370.0000 | 9.1759E-01 | 4.7271E-13 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| 555.0000 | 1.9543E+00 | 2.2745E-03 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| 740.0000 | 1.9590E+00 | 7.9239E-01 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| 925.0000 | 1.9590E+00 | 1.7099E+00 | 2.8519E-30 | 0.0000E+00 | 0.0000E+00 |
| 1110.0000 | 1.9590E+00 | 1.7385E+00 | 3.7015E-17 | 0.0000E+00 | 0.0000E+00 |
| 1295.0000 | 1.9590E+00 | 1.7386E+00 | 2.8181E-09 | 0.0000E+00 | 0.0000E+00 |
| 1480.0000 | 1.9590E+00 | 1.7386E+00 | 1.2138E-04 | 0.0000E+00 | 0.0000E+00 |
| 1665.0000 | 1.9590E+00 | 1.7386E+00 | 3.9466E-02 | 0.0000E+00 | 0.0000E+00 |
| 1850.0000 | 1.9590E+00 | 1.7386E+00 | 5.2322E-01 | 0.0000E+00 | 0.0000E+00 |
| 2035.0000 | 1.9590E+00 | 1.7386E+00 | 1.1049E+00 | 4.3440E-44 | 0.0000E+00 |
| 2220.0000 | 6.8523E-01 | 1.7386E+00 | 1.2113E+00 | 1.0060E-32 | 0.0000E+00 |

| | | | | | |
|---|---|---|---|---|---|
| 2405.0000 | 1.6355E-03 | 1.7296E+00 | 1.2152E+00 | 6.4452E-24 | 0.0000E+00 |
| 2590.0000 | 1.9940E-07 | 7.1631E-01 | 1.2153E+00 | 4.0285E-17 | 0.0000E+00 |
| 2775.0000 | 6.3576E-12 | 1.4180E-02 | 1.2153E+00 | 6.2566E-12 | 0.0000E+00 |
| 2960.0000 | 4.7054E-17 | 2.2008E-05 | 1.2153E+00 | 4.8890E-08 | 0.0000E+00 |
| 3145.0000 | 4.7054E-17 | 6.7374E-09 | 1.2153E+00 | 3.3226E-05 | 0.0000E+00 |
| 3330.0000 | 4.7054E-17 | 7.1921E-13 | 1.2149E+00 | 3.0407E-03 | 0.0000E+00 |
| 3515.0000 | 4.7054E-17 | 6.5703E-17 | 1.1499E+00 | 5.4393E-02 | 4.4463E-39 |
| 3700.0000 | 4.7054E-17 | 6.5703E-17 | 5.8937E-01 | 2.6920E-01 | 2.2526E-31 |
| 3885.0000 | 4.7054E-17 | 6.5703E-17 | 7.6672E-02 | 5.3600E-01 | 6.5901E-25 |
| 4070.0000 | 4.7054E-17 | 6.5703E-17 | 2.3003E-03 | 6.4933E-01 | 1.6473E-19 |
| 4255.0000 | 4.7054E-17 | 6.5703E-17 | 1.9513E-05 | 6.6777E-01 | 4.8681E-15 |
| 4440.0000 | 4.7054E-17 | 6.5703E-17 | 5.8463E-08 | 6.6904E-01 | 2.2321E-11 |
| 4625.0000 | 4.7054E-17 | 6.5703E-17 | 7.4830E-11 | 6.6908E-01 | 1.9998E-08 |
| 4810.0000 | 4.7054E-17 | 6.5703E-17 | 4.7831E-14 | 6.6908E-01 | 4.2701E-06 |
| 4995.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | 6.6901E-01 | 2.5809E-04 |
| 5180.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | 6.6418E-01 | 5.1778E-03 |
| 5365.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | 5.9686E-01 | 4.0091E-02 |
| 5550.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | 3.6025E-01 | 1.4035E-01 |
| 5735.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | 1.0790E-01 | 2.6692E-01 |
| 5920.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | 1.4328E-02 | 3.4217E-01 |
| 6105.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | 8.5507E-04 | 3.6454E-01 |
| 6290.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | 2.4323E-05 | 3.6804E-01 |
| 6475.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | 3.5287E-07 | 3.6835E-01 |
| 6660.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | 2.7952E-09 | 3.6836E-01 |
| 6845.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | 1.2844E-11 | 3.6795E-01 |
| 7030.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | 3.6056E-14 | 3.6117E-01 |
| 7215.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | -1.1438E-17 | 3.1881E-01 |
| 7400.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | -1.1438E-17 | 2.1042E-01 |
| 7585.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | -1.1438E-17 | 8.7314E-02 |
| 7770.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | -1.1438E-17 | 2.0883E-02 |
| 7955.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | -1.1438E-17 | 2.8254E-03 |
| 8140.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | -1.1438E-17 | 2.1952E-04 |
| 8325.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | -1.1438E-17 | 1.0081E-05 |
| 8510.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | -1.1438E-17 | 2.8248E-07 |
| 8695.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | -1.1438E-17 | 5.0016E-09 |
| 8880.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | -1.1438E-17 | 5.7753E-11 |
| 9065.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | -1.1438E-17 | 4.4820E-13 |
| 9250.0000 | 4.7054E-17 | 6.5703E-17 | -1.3769E-17 | -1.1438E-17 | 2.3871E-15 |


cis-1,2 Dichloroethylene
2.00
1.50
1.00
0.50
0.00
Concentration (mg/l)
0
1825
3650
5475
7300
9125
time since release (days)
Csource = 2.150 mg/l
release duration = 5 years
velocity = 0.4 m/day
DL = 100 meters
half life = 3.94 years
R = 1.5
100 m
200 m
500 m
1000 m
1500 m

```
***********************************************************
*
*    INTERNATIONAL GROUND WATER MODELING CENTER
*
*                  S O L U T E   version 3.0
*
*     ANALYTICAL MODELS FOR SOLUTE TRANSPORT
*
***********************************************************
```

Model: ONEd-3

PROJECT......... = IAWC-Webb
USER NAME....... = WHPA-Inc.
DATE............ = 06-24-97
DATA FILE....... = fbd100.dat

INPUT DATA:

GROUNDWATER (SEEPAGE) VELOCITY = .4 [m/d]
***LONGITUDINAL DISPERSIVITY..... = 100 [m]***
RETARDATION FACTOR............ = 1.5
INITIAL CONCENTRATION......... = 0 [mg/l]
CONCENTRATION AT SOURCE....... = 2.21 [mg/l]
LENGTH OF TIME STEP........... = 182 [d]
NUMBER OF TIME STEPS.......... = 50
NUMBER OF OBSERVATION POINTS.. = 5
1 DISTANCE (from source). = 100 [m]
2 DISTANCE (from source). = 200 [m]
3 DISTANCE (from source). = 500 [m]
4 DISTANCE (from source). = 1000 [m]
5 DISTANCE (from source). = 1500 [m]
DURATION OF SOLUTE PULSE...... = 1825 [d]
HALF-LIFE (0 if no decay)..... = 1450 [d]
DECAY CONSTANT (lambda)....... = .4780D-03 [1/d]

CONCENTRATION C [mg/l]

| TIME [d] | 1 DISTANCE 100.00 [m] | 2 DISTANCE 200.00 [m] | 3 DISTANCE 500.00 [m] | 4 DISTANCE 1000.00 [m] | 5 DISTANCE 1500.00 [m] |
|---|---|---|---|---|---|
| 182.0000 | 4.2412E-01 | 6.8980E-02 | 1.4698E-06 | 8.2933E-23 | 0.0000E+00 |
| 364.0000 | 8.5754E-01 | 3.4478E-01 | 1.9171E-03 | 2.8318E-11 | 1,6806E-24 |
| 546.0000 | 1.1350E+00 | 6.2725E-01 | 2.2936E-02 | 2.2147E-07 | 6.1142E-16 |
| 728.0000 | 1.3188E+00 | 8.5654E-01 | 8.0749E-02 | 2.0030E-05 | 1.1961E-11 |
| 910.0000 | 1.4450E+00 | 1.0329E+00 | 1.7131E-01 | 2.9727E-04 | 4.4772E-09 |
| 1092.0000 | 1.5339E+00 | 1.1668E+00 | 2.8038E-01 | 1.7720E-03 | 2.2928E-07 |
| 1274.0000 | 1.5978E+00 | 1.2683E+00 | 3.9463E-01 | 6.2415E-03 | 3.7494E-06 |
| 1456.0000 | 1.6446E+00 | 1.3454E+00 | 5.0496E-01 | 1.5784E-02 | 2.9877E-05 |
| 1638.0000 | 1.6792E+00 | 1.4041E+00 | 6.0623E-01 | 3.1963E-02 | 1.4733E-04 |
| 1820.0000 | 1.7051E+00 | 1.4492E+00 | 6.9614E-01 | 5.5371E-02 | 5.1853E-04 |

| | | | | | |
|---|---|---|---|---|---|
| 2002.0000 | 1.3152E+00 | 1.4205E+00 | 7.7416E-01 | 8.5606E-02 | 1.4270E-03 |
| 2184.0000 | 8.9137E-01 | 1.1741E+00 | 8.3906E-01 | 1.2153E-01 | 3.2642E-03 |
| 2366.0000 | 6.2192E-01 | 9.1126E-01 | 8.7514E-01 | 1.6159E-01 | 6.4752E-03 |
| 2548.0000 | 4.4484E-01 | 6.9660E-01 | 8.6545E-01 | 2.0413E-01 | 1.1484E-02 |
| 2730.0000 | 3.2419E-01 | 5.3149E-01 | 8.1477E-01 | 2.4736E-01 | 1.8621E-02 |
| 2912.0000 | 2.3968E-01 | 4.0648E-01 | 7.3842E-01 | 2.8904E-01 | 2.8077E-02 |
| 3094.0000 | 1.7924E-01 | 3.1202E-01 | 6.5091E-01 | 3.2634E-01 | 3.9879E-02 |
| 3276.0000 | 1.3528E-01 | 2.4049E-01 | 5.6237E-01 | 3.5641E-01 | 5.3882E-02 |
| 3458.0000 | 1.0290E-01 | 1.8609E-01 | 4.7886E-01 | 3.7715E-01 | 6.9767E-02 |
| 3640.0000 | 7.8784E-02 | 1.4454E-01 | 4.0341E-01 | 3.8765E-01 | 8.7028E-02 |
| 3822.0000 | 6.0660E-02 | 1.1266E-01 | 3.3716E-01 | 3.8815E-01 | 1.0498E-01 |
| 4004.0000 | 4.6934E-02 | 8.8096E-02 | 2.8012E-01 | 3.7979E-01 | 1.2283E-01 |
| 4186.0000 | 3.6470E-02 | 6.9092E-02 | 2.3168E-01 | 3.6422E-01 | 1.3970E-01 |
| 4368.0000 | 2.8448E-02 | 5.4335E-02 | 1.9097E-01 | 3.4326E-01 | 1.5480E-01 |
| 4550.0000 | 2.2266E-02 | 4.2837E-02 | 1.5699E-01 | 3.1867E-01 | 1.6746E-01 |
| 4732.0000 | 1.7481E-02 | 3.3851E-02 | 1.2881E-01 | 2.9203E-01 | 1.7721E-01 |
| 4914.0000 | 1.3763E-02 | 2.6807E-02 | 1.0552E-01 | 2.6462E-01 | 1.8380E-01 |
| 5096.0000 | 1.0863E-02 | 2.1271E-02 | 8.6341E-02 | 2.3745E-01 | 1.8718E-01 |
| 5278.0000 | 8.5938E-03 | 1.6910E-02 | 7.0587E-02 | 2.1127E-01 | 1.8748E-01 |
| 5460.0000 | 6.8133E-03 | 1.3466E-02 | 5.7670E-02 | 1.8660E-01 | 1.8499E-01 |
| 5642.0000 | 5.4124E-03 | 1.0741E-02 | 4.7132E-02 | 1.6374E-01 | 1.8007E-01 |
| 5824.0000 | 4.3074E-03 | 8.5800E-03 | 3.8479E-02 | 1.4286E-01 | 1.7314E-01 |
| 6006.0000 | 3.4338E-03 | 6.8636E-03 | 3.1408E-02 | 1.2403E-01 | 1.6463E-01 |
| 6188.0000 | 2.7417E-03 | 5.4979E-03 | 2.5634E-02 | 1.0720E-01 | 1.5498E-01 |
| 6370.0000 | 2.1923E-03 | 4.4094E-03 | 2.0920E-02 | 9.2291E-02 | 1.4456E-01 |
| 6552.0000 | 1.7555E-03 | 3.5407E-03 | 1.7074E-02 | 7.9178E-02 | 1.3374E-01 |
| 6734.0000 | 1.4075E-03 | 2.8462E-03 | 1.3936E-02 | 6.7717E-02 | 1.2279E-01 |
| 6916.0000 | 1.1299E-03 | 2.2904E-03 | 1.1376E-02 | 5.7754E-02 | 1.1198E-01 |
| 7098.0000 | 9.0808E-04 | 1.8450E-03 | 9.2871E-03 | 4.9134E-02 | 1.0148E-01 |
| 7280.0000 | 7.3062E-04 | 1.4876E-03 | 7.5834E-03 | 4.1707E-02 | 9.1436E-02 |
| 7462.0000 | 5.8845E-04 | 1.2006E-03 | 6.1555E-03 | 3.5331E-02 | 8.1961E-02 |
| 7644.0000 | 4.7441E-04 | 9.6976E-04 | 5.0257E-03 | 2.9874E-02 | 7.3116E-02 |
| 7826.0000 | 3.8283E-04 | 7.8395E-04 | 4.1041E-03 | 2.5219E-02 | 6.4940E-02 |
| 8008.0000 | 3.0921E-04 | 6.3548E-04 | 3.3521E-03 | 2.1258E-02 | 5.7446E-02 |
| 8190.0000 | 2.4995E-04 | 5.1460E-04 | 2.7386E-03 | 1.7894E-02 | 5.0627E-02 |
| 8372.0000 | 2.0222E-04 | 4.1702E-04 | 2.2378E-03 | 1.5044E-02 | 4.4465E-02 |
| 8554.0000 | 1.6416E-04 | 3.3818E-04 | 1.8290E-03 | 1.2634E-02 | 3.8929E-02 |
| 8736.0000 | 1.3304E-04 | 2.7443E-04 | 1.4952E-03 | 1.0599E-02 | 3.3982E-02 |
| 8918.0000 | 1.0790E-04 | 2.2284E-04 | 1.2226E-03 | 8.8830E-03 | 2.9583E-02 |
| 9100.0000 | 8.7571E-05 | 1.8106E-04 | 9.9992E-04 | 7.4388E-03 | 2.5688E-02 |